# Revised Annotated Bibliography on the Dolly Varden Char*

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***and***

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# REVISED ANNOTATED BIBLIOGRAPHY ON THE DOLLY VARDEN CHAR*

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This revised bibliography adds 377 additional references to the 13C published by Armstrong (1965) on the Dolly Varden, *Salvelinus malmc* (Walbaum). In this revision we have attempted to include all known literature. published or unpublished, on the Dolly Varden through 1968. We woulc appreciate being informed of any references to Dolly Varden known to the reader that are not included in this bibliography, as well as corrections oi pertinent additions to our annotations so they may be included in future revisions or addendums.

Some of the articles listed were not read by us. These are indicated by reference sources in the bibliography. A few references are not annotated These include ones to which reference has been made in other publications as containing information on Dolly Varden, but were unobtainable for our review. When abstracts or summaries pertaining specifically to Dolly Varder have been included in papers, we have transcribed them verbatim; they appeai in quotation marks, as do certain paragraphs cited in summary fashion from the body of a work. Otherwise, we have written the abstracts.

A subject index is included to aid the reader in his search of the Dolly Varden literature. Although all of the references are included in the index the index does not necessarily cover all of the subjects included on Dolly Varden in a particular article. This may be especially true for those articles not reviewed by us. For these we have indexed from the title or the abstracts written by others. The country or state where the study was conducted is included in parentheses after the authors in the subject index. If the information on Dolly Varden is not from a specific country or state, the word "general" appears after the author.

*One of the authors believes the correct spelling of this proper noun should be char (Morton, William M. 1955. Charr or char — history of a common name fo *Salvelinus*. Science, 121(3155):874-875).

1965. Inventory and cataloging of the sport fish and sport fish waters in upper Southeast Alaska. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1964-1965, Project F-5-R-6, Vol. 6, pp. 1 - 8.

Lists several lakes and streams in upper Southeastern Alaska where Dolly Varden are present.

**Andrews, Rupert E. and Robert Baade**

1966. Saltwater sport fish harvest studies in Southeast Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1965-1966, Project F-5-R-7, Vol. 7, pp. 19 - 38.

Presents limited information on the sport catch of Dolly Varden in saltwater.

**Andrews, Rupert E., Larry Heckart and Robert Baade**

1966. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration. Annual Report of Progress, 1965-1966, Project F-5-R-7, Vol. 7, pp. 1 - 17.

Information is presented on the number and size of Dolly Varden gillnetted from several lakes in Southeastern Alaska.

Also contains information on the Dolly Varden egg take at the Katlian River (also see Nagata, 1967).

**Andrievskaya, L. D.**

1957. (The summer migrations of Pacific salmon and their food during the sea period of life). Izv. Tikhookeansk. N. - I. In-ta Rybn. Kh-va i Okeanograf. (TINRO). t. XLIV.

Food of anadromous *Salvelinus malma* in the ocean.

**Andriyashev, Anatoly P.**

1937. A contribution to the knowledge of the fishes from the Bering and Chukchi Seas. Explorat. des mers de l 'URSS, fasc. 25, Inst. Hydro., Leningrad, pp. 292 - 355. 27 figs. [In Russian with English summary pp. 351 - 355]. Translated by Lisa Lanz with Norman J. Wilimovsky 1955. In U.S. Fish and Wildlife Special Scientific Report: Fisheries No. 145.

"The northern limit of *malma* is Bering Strait (settlement at Cape Dezhnev). The local Chukchee insist that forms living in the shallow lagoons divided from the sea by a narrow sand bar differ from the sea forms."

No other information on the Dolly Varden is available in this article.

1954. Ryby severnykh morei SSSR (Fishes of the northern seas of the U.S.S.R.) Izdatel'stvo Akademii Nauk SSSR, Moskva-Leningrad. Translated into English by the Israel Program for Scientific Translations, Jerusalem, 1964.

The article includes information on the distribution, description (coloration, morphometric and meristic data), habits and commercial value of the Dolly Varden in the U.S.S.R.

The author states that the life history of the Dolly Varden "has been inadequately studied."

**Anonymous**

1964. Cooper Lake hydroelectric project Kenai Peninsula Alaska. An initial follow-up report on the Fish and Wildlife resources. U.S. Fish and Wildlife Service, Juneau, Alaska. 9 pp.

"Access to Cooper Lake Reservoir created by the project has resulted in increased recreational use and substantial gains in fishing pressure. During a 1-month creel census period in 1962, 826 anglers caught 3,665 Dolly Varden, for an average of 4.4 fish per angler. Although quantitative data are lacking for the pre-impoundment



period, Dolly Varden appear to be in better condition now than before project development. Analysis of scales and measurements of total length reveal the following age and length ranges for 190 Dolly Varden taken in 1962:

| Age | Length Range |
|---|---|
| 0 year | —— |
| 1 year | —— |
| 2 year | 167 - 190 mm. |
| 3 year | 205 - 250 mm. |
| 4 year | 245 - 325 mm. |
| 5 year | 312 - 380 mm. |
| 6 year | 373 - 380 mm. |
| 7 year | 419 mm. (one specimen only) |

"No young fish of the year have been taken by sampling operations in the past 2 years, nor has any other evidence been found that the Dolly Varden population is reproducing."

**Armstrong, Robert H.**

1963. Investigations of anadromous Dolly Varden populations in the Lake Eva - Hanus Bay drainages, Southeastern Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration. Annual Report of Progress, 1962-1963, Project F-5-R-4, Vol. 4, pp. 78 - 122.

"This report covers the first year's operation of a project designed to study the life history of the Dolly Varden char, *Salvelinus malma* (Walbaum). The entire out-migration population (38,264) of Dolly Varden, utilizing a typical Southeast Alaska lake-stream system, were enumerated and marked. The fall inmigration (92,618) of this species was enumerated and checked for identifying marks. Sampling in other freshwater systems revealed migrations as far as 50 miles. Studies were also conducted to gather information on food and feeding habits; age and growth; sex ratio; spawning requirements; fecundity and freshwater rearing requirements."

1964. Some migratory habits of the anadromous Dolly Varden *Salvelinus malma* (Walbaum) in Southeastern Alaska. Master of Science Thesis, University of Washington, Seattle, Washington. 50 pp.

Later published as Alaska Department of Fish and Game Research Report No. 3 (see Armstrong, 1965a).

1965a. Some migratory habits of the anadromous Dolly Varden *Salvelinus malma* (Walbaum) in Southeastern Alaska. Alaska Department of Fish and Game, Research Report No. 3. 36 pp.

"The migratory habits of the Dolly Varden char were investigated at Eva Creek, a typical lake-stream system on Baranof Island, Southeastern Alaska, from May 1 to November 12, 1962, and from March 16, 1963 to March 15, 1964. A weir was built across Eva Creek, and all Dolly Varden migrating to sea from Eva Lake were enumerated and marked by fin clipping and/or tagging. After leaving Eva Creek, the Dolly Varden migrated in all possible directions. Marked fish were recovered in twenty-five different stream systems, some as far as seventy-two miles from Eva Creek. After an average of 116 days, 40 to 44 per cent of the marked fish returned to Eva Lake for the winter. In addition, large numbers of Dolly Varden which had not spent the winter in the lake entered it in the fall.

"A weir was built across Saook Creek, a non-lake system, located ten miles west of Eva Creek on Baranof Island. Thirty-seven per cent of the fish entering this system were marked fish from Eva Creek. By November all Dolly Varden of migratory size had left Saook Creek, and 68 per cent had entered Eva Lake for the winter.

"Major differences in the migratory habits of Dolly Varden entering the non-lake and lake-stream systems were found. It was believed that the lake-stream systems were being used as wintering areas by Dolly Varden originating in the many non-lake streams throughout this area."

1965b. Some feeding habits of the anadromous Dolly Varden *Salve-*

*linus malma* (Walbaum) in Southeastern Alaska. Alaska Department of Fish and Game Informational Leaflet No. 51. 27 pp.

"Stomach contents of 3,888 Dolly Varden were examined from fish captured during their outmigration at Eva Creek, in salt water, inmigrations at Eva and Saook Creeks and in Eva Lake during the summer and winter months.

"The digestive rate of Dolly Varden was studied by force feeding two sockeye salmon fry to each of 18 char. The fry were identifiable as salmon up to 12 hours after feeding and as fish remains at 16 hours after feeding. By 24 hours most digestion had been complete.

"The Dolly Varden as a predator of salmon young and eggs is discussed. It is concluded that until further evidence is collected the Dolly Varden should not be considered a serious threat as a predator on salmon young or on viable eggs which would have otherwise survived."

1965c. Annotated bibliography on the Dolly Varden char. Alaska Department of Fish and Game, Research Report No. 4. 26 pp.

"This bibliography brings together 130 references from Canada, Japan, Russia and the United States on the distribution, classification, life history, and general biology of the Dolly Varden."

1965d. Hello, Dolly. Alaska Sportsman Magazine. November, pp. 23-24.

Presents some general information on life history and where, when and how to fish for Dolly Varden.

1967. Investigation of Anadromous Dolly Varden populations in the Hood Bay drainages, Southeastern Alaska. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1966 - 1967, Project F-5-R-8, Vol. 8, pp. 33 - 56.

"This report presents the results of the first year's operation of the Hood Bay Creek weir and the fifth year of investigation of the life history of the Dolly Varden *Salvelinus malma* (Walbaum). Emphasis of study included determining the number of Dolly Varden entering Hood Bay Creek, the maturity composition of these inmigrants and the migration characteristics of the potential spawner and nonspawner char entering the system.

"An estimated 5,533 Dolly Varden entered Hood Bay Creek from the sea in 1966. This migration began in mid-June, peaked in late July and early August, and ended in early November. The inmigration was considered to consist of 2,158 (39%) potential spawners for the year, of which 988 (46%) and 1,170 (54%) were considered to be females and males, respectively. Egg size and ovary weights of the potential female spawners increased rapidly until the beginning of spawning in October. At this time their egg diameters were between 5.0 and 6.0 mm. A maturity index of 15 to 20 percent was calculated for the female Dolly Varden immediately prior to spawning in Hood Bay Creek.

"The majority of the Dolly Varden which had entered Hood Bay Creek in 1966 left the system in the same year. The immature Dolly Varden left the system soon after their date of entry while char spawning in Hood Bay Creek remained in the system until spawning was completed. The length of time spent in the system was reflected in their growth because length increment of the spawning char, while in the system, was three times greater than the nonspawning char.

"Dolly Varden spawning activity was first observed in Hood Bay Creek on October 21 and periodically thereafter until November 2. Hydraulic sampling of Dolly Varden eggs and pre-emergent fry resulted in estimates which may indicate an excellent survival of the char eggs during the 1966-67 winter.

"Stomach analysis of inmigrant char indicated that salmon eggs were the most frequently eaten food while the char were in Hood Bay Creek. Insects of the orders Plecoptera and Diptera were the most frequently found food item in rearing char."



**Armstrong, Robert H. and Roger F. Blackett**

1966a. Use and evaluation of dart tags to study the migration habits of Dolly Varden. *Salvelinus malma* (Walbaum). Transactions of the American Fisheries Society. 95(3):320-322.

"Dart tags were used to study the migratory habits of anadromous Dolly Varden entering and leaving Lake Eva located on the northeast corner of Baranof Island, Southeastern Alaska. A total of 2,428 char 149 mm and less in fork length and 23,372 char 150 mm and greater in fork length was tagged with dart tags and fin clipped to determine tag loss. Tag loss for the "small" fish group ranged from 44.3 percent at an average of 63 days between tagging and capture to 91.5 percent at an average of 429 days between tagging and capture. For the "large" fish group the tag loss ranged from 11.3 percent at an average of 120 days between tagging and capture to 27.7 percent at an average of 494 days after tagging. Information on tagging mortality and the immediate effects of tagging were obtained. The speed and ease of applying the dart tag were considered to be useful in tagging large numbers of char."

1966b. Digestion rate of the Dolly Varden. Transactions of the American Fisheries Society, 95(4): 429-430.

"A single experiment to obtain an indication of the rate at which Dolly Varden, *Salvelinus malma* (Walbaum) digest their food was conducted at the Eva Creek weir at Lake Eva on Baranof Island, Southeastern Alaska. Two freshly killed sockeye salmon fry, *Oncorhynchus nerka* (Walbaum) were force fed to each of eighteen Dolly Varden. At specific time intervals two char were sacrificed and the state of digestion of the salmon fry recorded. The water temperature was 56 Digestion of the fry was evident four hours and by sixteen hours feeding they could only be classifi fish remains. Digestion was n complete at twenty-four hours feeding."

**Armstrong, Robert H. and Peter Winslow**

1968. Investigation of anadromous I Varden populations in Hood drainages, Southeastern Al Alaska Department of Fish Game, Federal Aid in Fish Re ation, Annual Report of Pro 1967 - 1968, Project F-5-R-9. 9, pp. 45 - 80.

"This report presents the result the second year's operation of Hood Bay Creek weir and the year of investigation of the life hi of the Dolly Varden *Salvelinus m* (Walbaum). Emphasis of study cluded determining the numbe Dolly Varden smolts leaving the tem, the age composition of these migrants and their migration chara istics; the number of inmigrant D Varden and their homing tender and the frequency of Dolly Va spawning in Hood Bay Creek and mortality after spawning.

"A total of 9,277 Dolly Va smolts left Hood Bay Creek in Of these 6,735 left during a spring migration from mid-May to mid- and 2,545 during a fall outmigr from late September through Oct The age composition were mostly III and IV for the spring outmig and mostly age II and III for the outmigrants. Salmon young and in were the principal food items four these migrating smolts. Of the nu of char smolts marked, 8.7 percer turned to the system the same yea

"An estimated 5,954 Dolly Va entered Hood Bay Creek from the in 1967. This migration began in July, peaked in early August, and a in mid-September, and ended in November. The inmigration was sidered to consist of 2,084 (3

Biology and Fisheries 3(16):379-405.

Describes the occurrence of *S. alpinus malma* in Athabasca River, Rocky River, and Jaques Lake. Two forms occur in the river. One of them is a permanent freshwater fish, and the other a migrant from the sea.

Detailed description of coloration, morphometry, age, growth, and habits fit *S. malma* better than they do *S. alpinus*. One of the first North American papers to use the name *S. alpinus malma* and to present a table of morphometric measurements of *S. malma*.

**Bangham, Ralph V, and James R. Adams**

1954. A survey of the parasites of freshwater fishes from the mainland of British Columbia. Journal of the Fisheries Research Board of Canada, 11(6):673-708.

The Authors examined 51 Dolly Varden from 9 locations; all of these fish were found to be infected. *Crepidostomum farionis* and *Neoechinorhynchus rutili* were recovered in 69 percent of the hosts from all but 2 of the locations. *Eubothrium salvelini* was taken from 20 percent of the hosts and from all but 1 of the areas sampled.

**Banta, G. B.**

1936. Research — Dolly Varden Trout, Sitkoh Bay, Alaska. Unpublished report of the U.S. Forest Service, Juneau, Alaska. 4 pp.

"The total number of Dolly Varden taken was 1,940 fish, ranging in size from six (6) inches up to twenty-four (24) inches in length."

Of the Dolly Varden examined, 22 percent had fry in all stages of digestion, 1 percent contained fish eggs and 40 percent water bugs which appeared to be mosquitoes. Thirty-seven percent of the stomachs were empty.

"We found that 25 percent of all Dolly Vardens examined harbored the tape worm and 76 percent the round worm."

1937. Report on Dolly Varden trout research. Unpublished report of the U.S. Forest Service, Juneau, Alaska. 4 pp.

Some information is given on the timing of the Dolly Varden out-migration from Sitkoh Lake, Chichagof Island, Southeastern Alaska. Limited data on food and feeding habits are given.

**Barnaby, Joseph T. and A. C. DeLacy**

1938. Karluk River red salmon. Report of the U.S. Commissioner of Fisheries for 1938, App. I, pp. 31-33.

Information on food habits, migrations and growth of the Dolly Varden in Karluk River, Alaska is presented. The Dolly Varden predation on salmon fry and eggs is discussed.

**Barsukov, V. V.**

1960. Systematics of Chukot chars of the genus *Salvelinus*. (K sistematike Chukotskikh gol'tsov roda Salvelinus.) Voprosy Ikhtiol. 14: 3-17; Referat. Zhur., Biol., 1961. No. 7D382; Biological Abstracts, Vol. 36, No. 22, Abst. No. 78585. 1961.

"The three groups of chars from Lavrentiya Gulf, adjacent lakes, and from Lake Estikhet (Chukotka), and also, apparently, *S. taranetzi* Kaganowsky, belong to a single species, *S. malma* (Walbaum), and the latter is regarded as no more than a sspp. (synonym, group of subspecies?) of *S. alpinus*. The separation of the chars from Lake Estikhet into the separate sp. *S. andriashevi* Berg and its association with *S. leucomaenis* is based only on an error in the count of the gill rakers. (Auth.)"

**Bean, Tarleton H.**

1880. Check-list of N.A. Fishes distributed by the Smithsonian Institution in behalf of the U.S. National Museum 1877 - 1880. Proceedings, U.S. National Museum, III, 1880, pp. 75 - 116.

*Salvelinus bairdii* and *S. malma* reported from McCloud River in California.

1882a. A preliminary catalogue of the fishes of Alaskan and adjacent waters. Proceedings, U.S. National Museum, 1881, Vol. 4: 239-272.

Specimens of *Salvelinus malma* were collected from Port Althop; Chugachik Bay and Refuge Cove in Cock's Inlet; St. Paul in Kodiak; Humboldt Harbor and Little Koniuski Island in Shumagins; Illiuliuk and Natuken Bay in Unalaska; Kyska Harbor and Port Clarence and Cape Lisburne in 1880 by Dall and Bean. Also from St. Michaels and Unalaklik River by Turner in 1876.

1882b. A partial bibliography of the fishes of the Pacific Coast of the United States and Alaska, for the year 1880. Proceedings, U.S. National Museum, 1881, Vol. 4: 312-317.

1883. List of fishes known to occur in the Arctic Ocean north of Bering Strait. In cruise of Revenue-steamer Carwin in Alaska and Northwest. U.S. Government Printing Office: 118 - 120.

Mentions Dolly Varden were taken from Hotham Inlet on Kotzebue Island.

1887. The fishery resources and fishing grounds of Alaska. In The Fisheries and Fishery Industries of the U.S. by G. B. Goode, Section III: 81 - 115.

On page 94 and 96 refers to *malma* at Karluk and gives its Aleut name of Ahn-chuck; on page 108—"From the settlement at Port Clarence we obtained some dressed skins of the red-spotted trout (*Salvelinus malma*) which are used for making quite ornamental, water-proof vests. Small seines are used for their capture." Page 109 — "We took the young of red-spotted trou Cape Lisburne in the summer of . . ."

1888. Distribution and some chara of the Salmonidae. Amer Naturalist 22(257):306-314.

1889. Report on the Salmon and Sal Rivers of Alaska, with notes the conditions, methods, and n of the Salmon Fisheries. Bulle U.S. Fish Commission, Vol. 199 - 200.

A brief reference to the size occurrence in Alaska of *Salveli malma*.

1890. The Alaska Salmon and t allies. Transactions of the Am can Fisheries Society, 19:49-6

This article contains notes on distribution, habits and coloration the Dolly Varden in Alaska. Nati of Alaska made waterproof cloth from Dolly Varden skins. The east limit of this fish is in the headwa tributaries of the Saskatchewan Riv

1894. Bibliography of the Salmon Alaska and adjacent regio Bulletin of the U.S. Fish Comm sion, 12:39-49.

This compilation lists some ve early papers which contain limited formation on the Dolly Varden.

**Behnke, Robert J.**

1965. A systematic study of the Fam Salmonidae with special referen to the genus *Salmo*. Unpublish Ph.D. Thesis, Zoology, Univers of California, Berkeley. 273 p typewritten. Copies available fro University Microfilm, Inc., A Arbor, Michigan.

Discusses the Genus Salvelinus o pp. 210-222 and the probable taxonom relationship of *Salvelinus alpinus*, *malma*, and *S. leucomaenis* as vali species on pp. 219-221.

Block, Daniel G.
1955 Trout migrati and spawning studies on the North Fork

Stanage of the Flathead River. Master of Science Thesis, University of Montana. 83 pp.

Dolly Varden spawning occurs as early as the middle of August, and a few fish may not spawn until late October or early November. However, the peak of the spawning season is reached during September.

Readings obtained from 41 scale samples of mature Dolly Varden showed that the youngest were in their sixth year of growth (five annuli) and oldest fish was in its ninth year.

Tagging Dolly Varden in the Flathead River revealed migrations of over 100 miles.

Immature Dolly Varden left the tributaries at the age of three or four years.

**Bogdanov, E. A.**

1960. An endemic disease of Salmonids in Sakhalin Island. Translated from Doklady Akademii Nauk SSSR, Vol. 134, No. 6, pp. 1501-1503 by the American Institute of Biological Sciences in their "A Translation of Doklady Biological Sciences Sections," March - April. 1961, pp. 785 - 787.

The occurrence of the Myxosporidian parasite *Myxosoma cerebralis* in Dolly Varden is mentioned.

1963. Parasite fauna of salmonids from rivers of South Sakhalin. (In Russian, English summary.) Izv. Gos. Nauchn. Issled. Inst. Ozern. Rechn. Rybn. Khoz 54:15-47.

Parasites found in Dolly Varden.

**Borisov, P. G. and**
**N. S. Ovsyannikov**

1951. Opredelitel' promyslovykh ryb SSSR (Key to Commercial Fishes of the USSR) — Moskva, Pishchepromizdat, 180 pp., ill. (Kafedra ikhtiologii i syr'evoi bazy Moskovskogo teknicheskogo instituta rybnoi promyshlennosti im. A.I. Mikoyana). Taken from Romanov (1966), Abst. No. 2156.

"Key to marine and freshwater commercial fishes, described in the article 'Commercial Fishes of the USSR.' (No. 2027). Key to families, genera and species."

1954. Opredelitel' promyslovykh ryb SSSR (Key for the Identification of Commercial Fishes of the USSR). — Moskva, Pishchepromizdat, 2nd ed., revised and enlarged, 260 pp., ill. (Kafedra ikhtiologii i syr'evoi bazy Moskovskogo tekhnicheskogo instituta rybnoi promyshlennosti im. A. I. Mikoyana). Taken from Romanov (1966), Abst. No. 2505.

"Key for identification of commercial marine and freshwater fishes described in the report 'Promyslovye ryby SSSR' (No. 2027). Determination of families, genera and species."

**Bower, Ward T.**

1919. Alaska fisheries and fur industries in 1918. Appendix VII to the Report of the U.S. Commissioner of Fisheries for 1918. Bureau of Fisheries Document No. 872. pp. 1 - 128.

"The trout fishery of Alaska has not attracted much attention although it is of growing importance. One concern, the Midnight Sun Packing Co., at Kotzebue, reports that its major operations consisted of the catching and packing of Dolly Varden trout. This company canned 2,587 cases of trout, the value of which was $24,105, or more than the value of all the trout products of Alaska, in 1917."

During 1918 approximately 56,000 pounds of Dolly Varden were marketed either fresh or frozen, 125,760 pounds were canned and approximately 19,600 pounds were pickled for a total of 201,360 pounds with a value of $32,243.

1920. Alaska fisheries and fur industries in 1919. Appendix IX to the Report of the U.S. Commissioner of Fisheries for 1919. Bureau of Fisheries Document No. 891. pp. 1 - 160.

The commercial Dolly Varden catch for 1919 was approximately 88,000 pounds valued at $11,670. The majority of the catch came from Southeastern Alaska and were marketed fresh.

"The most notable change in respect to the trout fisheries of Alaska in 1919 was the failure to operate of the Midnight Sun Packing Co., at Kotzebue, where 2,587 cases of Dolly Vardens were canned in 1918 — the largest single product of the trout fisheries." The canning and pickling of trout [Dolly Varden] almost ceased in 1919: only 359 cases, valued at $3,388, were packed, largely by four salmon-canning companies in central Alaska, and 11 barrels were salted in western Alaska.

1921. Alaska fishery and fur-seal industries in 1920. Appendix VI to the Report of the U.S. Commissioner of Fisheries for 1921. Bureau of Fisheries Document No. 909. pp. 1 - 154.

Contains a report of the U.S. Bureau of Fisheries' first efforts to destroy "predatory fishes" (including Dolly Varden) in the Bristol Bay Region.

The Dolly Varden commercial production was approximately 34,500 pounds with a value of $7,521. The bulk of the catch of Dolly Varden was handled as fresh or frozen fish by the Ripley Fish Co., and Libby, McNeil & Libby, located in Southeast Alaska.

1922. Alaska fishery and fur-seal industries in 1921. Appendix X to the report of the U.S. Commissioner of Fisheries for 1922. Bureau of Fisheries Document No. 933. pp. 1 - 85.

Contains a report of the Bureau of Fisheries work during 1921 to control "predatory fishes" in the Bristol Bay region. The total take for the season was 34,758 fish, totaling 122,762 pounds. Dolly Varden comprised the bulk of the take.

The commercial production of Do
Varden in 1921 was 110,577 pou
valued at $16,275. The bulk of
output came from Southeast Alas

1923. Alaska fishery and fur-seal
dustries in 1922. Appendix IV
the Report of the U.S. Comm
sioner of Fisheries for 1923.
reau of Fisheries Document
951. pp. 1 - 118.

Reports on the Bureau of Fishe
efforts to destroy "predatory fish"
the Bristol Bay region during 1
Approximately 28,000 Dolly Va
were destroyed during the season
The commercial Dolly Varden c
for 1922 was 49,483 pounds value
$4,275.

1925a. Alaska fishery and fur-seal
dustries in 1923. Appendix
to the Report of the U.S. C
missioner of Fisheries for 1
Bureau of Fisheries Docu
No. 973. pp. 1 - 140.

Bower reports that the destru
of "predatory fish" (including D
Varden) begun in 1920 in the B
Bay district, "is showing result
every section . . . and trout are
difficult to capture each year."

Approximately 35,500 Dolly Va
were destroyed in the Bristol Bay
trict in 1923.

The commercial Dolly Varden
in 1923 was 18,145 pounds valu
$2,068. Most of the Dolly Va
marketed were caught incident
the other fishery operations.

1925b. Alaska fishery and fur-sea
dustries in 1924. Appendix
the Report of the U.S. Co
sioner of Fisheries for 1925
reau of Fisheries Documen
992. pp. 1 - 169.

During 1924 approximately 7
Dolly Varden from the Bristol
district were destroyed by the B
of Fisheries as part of their prec
fish control program.

"The production of trout in A
in 1924 was wholly incidental to

and weight. The average length was from 10 to 12 inches and the weight from 8 to 10 ounces. An examination of the stomachs of many taken in seines revealed the fact that they were gorged with salmon fry, and their excellent condition was added proof that they had been well fed during the winter. In October and November, 1911, thousands of Dolly Vardens gathered at the outlet of the flume discharging from the hatchery and were taken by seines, as many as a small dory full at one haul. These fish were of all sizes, but the average length was about 10 inches and weighed a third of a pound. Throughout the winter wire traps were set for them, and in this manner several hundred more were destroyed."

A total of 46,540 lbs. of Dolly Varden valued at $3,278 were sold commercially from Alaska in 1913.

**Brett, J. R.**

1946. Lakes of the Skeena River drainage, IV. Kitsumgallum Lake. Fisheries Research Board of Canada's Progress Reports of the Pacific Coast Stations. No. 69. pp. 63 - 76.

"As if the physical and food conditions had not already imposed enough limitations on sockeye salmon production in Kitsumgallum Lake, another restrictive factor is present in the occurrence of two predator fish, the Dolly Varden char, *Salvelinus malma*, and cutthroat trout, *Salmo clarkii*. The former, from the examination of the stomach contents of 21 specimens, subsist largely on fish (98%). The latter had an average of 47% fish in the stomachs of 20 individuals. Fourteen per cent of these were Salmonidae but many of the specimens were too badly digested to be identifiable to species. In spite of the lack of positive identification of many sockeye yearlings in the stomachs, the two species certainly represent a sizeable source of potential predation in Kitsumgallum."

**Brooke, Major John**

1895. Another Dolly Varden Trip—Circa 1870. Recreation Magazine. February. Reprinted in Alaska Sportsman Magazine — April 1967.

An account of fishing for Dolly Varden in Southeastern Alaska.

**Brunson, Royal B.**

1952. Egg counts of *Salvelinus malma* from the Clark's Fork River, Montana. Copeia No. 3, pp. 196-197.

Actual egg counts were made on 28 Dolly Varden. It was found that an average of 962±114 eggs were produced per pound of fish, with a range of 795 to 1,210. The fish ranged in size from one pound, ten ounces to eight pounds, twelve ounces.

"No food material was found in any stomach, and furthermore, the contracted condition of the stomachs indicated that some time had passed since the last eating period."

**Budd, Williams**

1968. In Love With 'Dolly'. The Northwest Salmon Trout Steelheader, 1(4):32-34.

Dolly Varden in western Washington waters.

**Campbell, J. B.**

1882. Notes on McCloud River, California and some of its fishes. U.S. Fish Commission Bulletin, Vol. 1 (1881), pp. 44 - 46.

Refers to spawning of Dolly Varden or Swye-dar-deek-it (*S. malma spectabilis*) in fall.

**Carl, G. C.; W. A. Clemens, and C. C. Lindsey**

1959. The Fresh-water Fishes of British Columbia. British Columbia Provincial Museum Handbook No. 5. third edition, 192 pp.

This handbook contains a description of the species, general distribution, and notes on the habits of Dolly Varden.



**Carlander, Kenneth D.**

1950. Handbook of freshwater biology. Wm. C. Brown Co., Dubuque, Iowa. 281 pp.

This handbook includes biological measurements reported in three papers on Dolly Varden.

1953. Handbook of freshwater fishery biology with the first supplement. Wm. C. Brown Co., Dubuque, Iowa. 429 pp.

This addition contains life history and biological measurements reported in three papers on Dolly Varden.

**Chamberlain, F. M.**

1907. Some observations on salmon and trout in Alaska. Report of the U.S. Commissioner of Fisheries for 1906. Bureau of Fisheries Document No. 627, 112 pp.

On page 19 is a detailed description and drawing of a Dolly Varden fry. On page 107-8 the stomach contents of 500 Dolly Varden examined at Karluk Alaska in 1903 and 1906 is presented.

**Chamberlain, F. M. and Ward T. Bower**

1913. Fishery industries. In fishery and fur industries of Alaska in 1912. Bureau of Fisheries Document No. 780. pp. 1 - 123.

"The trout fishery of Alaska is not of great importance, relatively speaking, notwithstanding the fact that the Dolly Varden or commonly-called salmon trout abounds. On account of its voracious habits the Dolly Varden is undoubtedly the most destructive natural enemy that young salmon have in fresh water. The suggestion is frequently heard that the Government ought to place a bounty on trout to aid in preserving the salmon industry. If practicable means could be found, it might be well to adopt this suggestion, for under present conditions trout are far less desirable in Alaska than salmon."

The 1912 commercial Dolly Varden catch was approximately 92,900 pounds valued at $4,709. Sixty-six thousand pounds were canned, 22,000 pounds pickled, 500 pounds frozen and the remainder marketed fresh. Most of the catch came from Western Alaska.

**Chapman, Wilbert McL. and Elmer Quistorff**

1938. The food of certain fishes of North Central Columbia River drainage, in particular, young chinook salmon and steelhead trout. Washington Department of Fisheries, Biological Report No. 37A, 14 pp.

"Eight of the 18 Dolly Varden stomachs were found to be empty. Out of the ten which contained food, four contained small salmonoid fish. These were the only small salmonoid fishes found in the 1,713 stomachs examined (includes all other species). Despite the scantiness of these data, this high percentage would indicate that Dolly Varden could be a distinct threat to the young salmon populations. Fortunately what little data are available indicate that the Dolly Varden populations in the rivers under consideration are small. The rest of the fish, with the exception of one containing an earthworm, had been eating insects." The length of these fish ranged from 134 to 240 mm.

**Chipperfield, W. A.**

1937a. Report on Dolly Varden Trout Research, Sitkoh Bay. Unpublished report of the U.S. Forest Service, Juneau, Alaska. 4 pp.

Mentioned that "Dolly Varden descended [from Sitkoh Lake] in two rather vaguely defined runs. One from May 1st to May 4th and the other from May 21st to May 30th."

Presents the daily catch of Dolly Varden in the Sitkoh Lake and Stream trap for 1937.

1937b. Report on Sport Fishing Grounds, Sitkoh Lake and Stream. Unpublished report of the U.S. Forest Service, Juneau, Alaska. 2 pp.

Game Resources 1960 - 2000. Report to Alaska Outdoor Recreation Council, Alaska Department of Fish and Game. 35 pp. (Out of print).

Estimated catch figures on Dolly Varden for 1961 are presented for the Southeastern District; Southcentral District and Southwestern District in Alaska.

**Crawford, Donald R.**

1925. Field characters identifying young salmonoid fishes in fresh waters of Washington. University of Washington Pub. 1(2):64-76.

Shows differences in juvenile *S. malma* and *S. fontinalis.*

**Darda, M. A.**

1964. Nekatorye dannye po biologii gol'tsa roda Salvelinus iz Yaponskogo morya. (Some data on the biology of char, genus *Salvelinus* of the Sea of Japan.) Izy Tikhookeanskogo Nauch-Issled Inst Rybn Khoz Okeanogr 55.227-229. From Ref. Zh Biol, 1965, No. 17159. Biological Abstracts, Volume 47. No. 24, Abst. No. 115701, 1966.

"(Translation)—In the Tatar Strait. in June 1961, 49 specimens of the southern diadromous Dolly Varden char were discovered in drift - net catches. The captured fish were longer than males by 1.5 cm. Stomachs contained anchovies and euphasiids. Gonads were in stage II of maturity; in 2 females they were in stages II-III and III. Two groups of oocytes were distinguished in the gonads: large; and small, white, yolkless. The latter were not expected to be spawned during the year in question. The number of large eggs was 2895-6626, with an average of 4500."

**DeLacy, A. C.**

1941. Contributions to the life histories of two Alaska chars, *Salvelinus malma* (Walbaum) and *Salvelinus alpinus* (Linnaeus), Ph.D. Thesis, University of Washington, Seattle, Washington, 114 pp.

In this work data on Dolly Varden include information about their range and distribution; descriptions (coloration, meristic and morphometric data); migration timing; time young spend in freshwater; marking or tagging and recapture; movements in the ocean; growth; time spent in the ocean and food and feeding habits.

**DeLacy, A. C. and W. M. Morton**

1942. Taxonomy and habits of the chars, *Salvelinus malma* and *Salvelinus alpinus*, of the Karluk drainage system. Transactions of the American Fisheries Society, 72:79-91.

"In the course of a study of the importance of chars as predators on the red salmon of the Karluk watershed on Kodiak Island, during the summers of 1939 to 1941, it became apparent that two distinct species of chars were present. Results of tagging experiments, of stomach examinations of thousands of chars, and of the analysis of comprehensive morphometric and meristic data made it easy to separate the Dolly Varden chars from the red lake or alpine chars at Karluk. These species have often been confused with each other, and may show intergradation in other parts of the world. At Karluk, however, the Dolly Varden char, *Salvelinus malma* (Walbaum), is typically anadromous, spawns in streams, and has fewer than 20 gill rakers and fewer than 35 pyloric caeca. The red lake or alpine charr, *Salvelinus alpinus* (Linnaeus), of the same region is not anadromous, spawns in the lake, and has more than 20 gill rakers and more than 35 pyloric caeca."

**Dimick, R. E. and Fred Merryfield**

1945. The Fishes of the Willamette River System in Relation to Pollution. OSC Engineering Experimental Station Bulletin Series No. 20, June 1945, pp. 33-34.

Gives distribution of *S. malma spectabilis* (Girard) in Oregon.



**Domrose, Robert**

1967. Inventory of waters of the project area. Job Completion Report, Federal Aid in Fish Restoration, Project F-7-R-15, Montana Fish and Game Department, 15 pp.

"The fish populations of 11 tributary streams to the Swan River above Swan Lake were censused with electrofishing gear to obtain general information regarding age, growth and population structure by species. Brook trout were found to be the most abundant game fish followed by Dolly Varden and cutthroat.

"Fish population surveys were conducted for 21 lakes in the district to provide additional information for the management of these lakes. Contour maps of 11 lakes were produced from electronic soundings. Opening day creel census information was collected for Kilbrennan and Mary Ronan Lakes to obtain angling pressure and catch rates."

**Dotson, Phil A.**

1963. Creel census of the sport fishes in the Bristol Bay drainage. Alaska Department of Fish and Game. Federal Aid in Fish Restoration. Annual Report of Progress, 1962-1963, Project F-5-R-4, Vol. 4. pp. 315 - 326.

Presents information on the sport catch of Dolly Varden in the Naknek River from 1956 to 1962.

**Dufresne, Frank**

1946. Alaska's Animals and Fishes. Published by Binfords and Mort. Portland, Oregon. 297 pp.

This is a general account of the habits, distribution and description of the Dolly Varden.

1963. Fishtail Poker. Field and Stream Magazine. January.

An interesting narrative about the bounty paid for Dolly Varden tails in Alaska before 1941.

**Dul'keit, G. A.**

1925. Spisok ryb basseina reki Suifuna (Yuzhno-Ussuriiskii krai) (A List of Fishes Found in the Basin of the Suifun River [South-Ussuri Territory]).—Izvestiya Tomskogo Gosudarstvennogo Universiteta, Vol. 75: 68-72. Taken from Romanov (1966), Abst. No. 160.

"The author presents a list of 42 fish species [including *S. alpinus malma*]. indicating their habitat, dimensions and common local names, as found in 1921 and 1922 mainly in the surroundings of the town Nikolsk-Ussuriiski (now Ussuriisk)."

1927. K f a u n e presnovodnykh ryb yuzhnogo Sikhote-Alinya (Ussuriiskii krai) (On the Fauna of Fresh-Water Fishes of Southern Sikhote-Alin (Ussuri Territory). — Ezhegodnik Zoologicheskogo Muzeya AN SSSR, 28(1):9-24. Taken from Romanov (1966), Abst. No. 350.

Short physicogeographical description of the region's rivers. A list of 33 fish species, "including *S. alpinus malma*, found by the author in 1919 and 1921; short description and some data on their biology and distribution."

**Dunn, Jean R.**

1960. Inventory and cataloging of sport fish and sport fish waters on the Kenai Peninsula and the Prince William Sound drainages. Alaska Department of Fish and Game. Federal Aid in Fish Restoration. Annual Report of Progress, 1959-1960, Project F-5-R-1, Vol. 1, pp. 15 - 22.

Length frequencies of Dolly Varden obtained in gill nets from Bear Lake and Upper Summit Lake in 1959 are presented.

1961a. Creel c e n s u s and population sampling of the sport fishes in the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration. Annual Report of Progress, 1960-1961, Project F-5-R-2, Vol. 2, pp. 97 - 114.

"Dolly Varden first occurred in the catch [Anchor River] on July 2. The harvest increased rapidly to a peak (240 fish) in the last week in July then declined gradually until another peak (210 fish) was attained during mid-September. The total observed catch was 1,110 Dolly Varden while an estimated 3,300 were taken during the duration of the creel census. Allin in 1957 estimated 400 were taken by anglers. The observed weekly and cumulative catch are shown in Figure 12. Size composition of 227 Dolly Varden (Figure 13) indicates the 12.0 to 12.9 inch length class is the most common."

1961b. Inventory and cataloging of the sport fish and sport fish waters on the Kenai Peninsula and Prince William Sound. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1960-1961, Project F-5-R-2, Vol. 2, pp. 13 - 28.

Presents some information on the gill net catch, and length and weight of Dolly Varden taken from lakes.

**Dymond, J. R.**

1932. The trout and other game fishes of British Columbia. Canada Department of Fisheries, Ottawa, 51 pp.

A general description of Dolly Varden is given on pages 37-39, with notes on range, color, distribution, measurements and habitats. Contains a color plate of a Dolly Varden. Author believes it should be called *S. alpinus malma*.

1936. Some freshwater fishes of British Columbia. Royal Ontario Museum Zoology Contribution, 9: 60-73.

1937. Some Fresh-water Fishes of British Columbia. Report of the Commissioner of Fish for 1935 (Canada). pp. 63-73.

Page 63 describes the Dolly Varden lists waters of British Columbia in which it is found; also some morphometric and meristic counts.

1942. The Occurrence of the Dolly Varden charr in salt water off British Columbia. Canadian Field Naturalist 14(7):110-112.

Describes its range and quotes 18 reports on the occurrence of Dolly Vardens on Pacific Coast, and concludes that "the Dolly Varden commonly enters the sea from 50° N. latitude northward, but that south of this point, its occurrence in salt water is not common and occurs only under special and peculiar circumstances."

**Elrod, Morton J.**

1930. The Fishes of Flathead Lake. University of Montana, Missoula. Mimeographed, 8 pp.

On page 4, Dr. Elrod writes about two bull trout chasing a school of Columbia River chubs that were all taken in a gill net. The bull trout stomachs were empty, and these 3-pound fish were heavily parasitized. Bull trout are the largest fish found in Flathead Lake. In 1916, one James Hyer caught a bull trout in Flathead Lake that weighed 25 lbs., 10 oz., and was 27 inches long, and 25 inches in girth.

**Engel, Larry J.**

1965. Inventory and cataloging of the sport fish and sport fish waters on the Kenai Peninsula, Cook Inlet - Prince William Sound areas. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1964-1965, Project F-5-R-6, Vol. 6, pp. 111 - 127.

The length and number of Dolly Varden gill-netted from several North Kenai lakes, Finger Lakes and Swan Lake systems in 1964 is presented.

1967. Inventory and cataloging of the sport fish and its waters on the Kenai, Cook Inlet - Prince William Sound areas. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1966-1967, Project F-5-R-8, Vol. 8, pp. 73 - 81.

Three hundred ninety-one Dolly Varden (43.8 percent of the catch) were recorded from the Kachemak Bay sport harvest in 1966.



**Evermann, Barton W.**

1893. A reconnaissance of the streams and lakes of western Montana and northwestern Wyoming. Bulletin of the U.S. Fish Commission. Vol. XI for 1891, pp 3 - 60.

Deals with natural history features of trout streams and distribution of fishes as well as requirements for fish-cultural stations. Distributional and descriptive notes on *Salvelinus malma* are given, and a black and white plate of the Dolly Varden is included. Contains an account of 6 specimens of *S. malma* 6 to 10 inches long from Rattlesnake Creek near Missoula, Montana, with chart of 11 body measurements and colors described.

1897. A report upon salmon investigations in the headwaters of the Columbia River, in the state of Idaho, in 1895, together with notes upon the fishes observed in that state in 1894 and 1895. Bulletin of the United States Fish Commission for 1896, Vol. 16. pp. 149 - 202.

"The bull trout was seen by us in Salmon River and Alturas and Pettit lakes, inlets and outlets. It was not seen in Yellowbelly, Redfish, or Big Payette Lake, but it is said to occur in all those waters. Not until these investigations was the Dolly Varden or bull trout known to occur in the Snake River basin, and it is not yet known from any point above the Great Shoshone Falls. In Salmon River and Alturas Creek it seemed to be quite common during July and August, and could be readily taken on the hook with almost any kind of bait. Salmon spawn tied up in pink mosquito bar, grasshoppers, and fish liver were excellent bait. It would sometimes take the fly and always provided a vigorous fighter. In these waters this species attains a weight of 3 or 4 pounds. Its spawning season is in August and September.

"This is the only fish, excepting young salmon, which we saw in Alturas Inlet with the spawning redfish. On September 8 a large male bull trout, 22 inches long and weighing 3 pounds, was found in Alturas Inlet near the mouth. This was a spent fish and seemed in good condition except that the upper caudal lobe was gone, apparently bitten off by some animal. The spots on sides were very bright red, and the belly as high up as the pectorals was a beautiful rosy red; the anal, ventrals, and pectorals margined with white, that on the pectoral inclining to yellowish."

**Evermann, Barton W. and Harold C. Bryant**

1919. California Trout. California Fish and Game, 5(3):105-135.

Mentions: "The Dolly Varden (*Salvelinus parkei*) is the only charr native to California streams. Its distribution in this state is limited to the McCloud River."

**Evermann, Barton W. and Howard Walton Clark**

1931. A distributional list of the species of freshwater fishes known to occur in California, California Fish and Game. Fish Bulletin 35. 67pp.

Contains a bibliography of literature published up to that date. Summary for *S. malma* on p. 50 states: "25. (380) *Salvelinus malma spectabilis* (Girard) Dolly Varden Trout; Oregon Charr; Bull Trout; Red-spotted Trout; Golet. McCloud River (Bean 1880 as *S. bairdi*); lakes and streams of the Cascade Range from Mt. Shasta northward to Alaska (Jordan and Gilbert 1881 as *S. malma*); McCloud River (Campbell 1882 as "Dolly Varden"). Upper Sacramento (Jordan 1894 as *S.*

*malma*); Upper Soda Springs on Sacramento (Jordan 1907 as *S. malma*)."

**Evermann, Barton W. and E. L. Goldsborough**

1907. The fishes of Alaska. In Bulletin of the U.S. Bureau of Fisheries, 1906, Vol. 26:219-360.

This discusses the distribution of Dolly Varden in Alaska, their habits, methods of sport fishing and desirability as a game fish. Included is a color plate of an adult female.

**Evermann, Barton Warren, and Seth Eugene Meek**

1898. A report upon salmon investigations in the Columbia River basin and elsewhere on the Pacific Coast in 1896. Bulletin of the United States Fish Commission for 1897, Vol. 17:15-84.

*Salvelinus malma* (Walbaum). Dolly Varden Trout; Western Charr; Bull Trout. "Obtained in Alturas, Pend d'Oreille, and Wallowa lakes, where it is abundant and affords good sport for the angler. At Alturas Lake during July a great many were caught about the mouth of the inlet and many large examples were taken in Lake Pend d'Oreille. The charr is a voracious fish and preys largely upon other species of fishes. In the stomachs of some of those examined at Lake Pend d'Oreille were numerous specimens of *Leuciscus balteautus, Ptychocheilus oregonensis, Mylocheilus caurinus,* and *Cottus.* All of these except *M. caurinus* were found in the stomach of one fish. Some specimens from this lake were infested about the axils by a small crustacean of the genus *Lernaeopoda.*"

Comparative measurements from nine Dolly Varden are presented.

**Foerster, R. E.**

1930. A Dolly Varden as a salmon conservationist. Copeia, No. 3, p. 90.

This is a short article describing the food of a single specimen "On May 8, 1930, there was caught in Cultus Lake, British Columbia, a male Dolly Varden charr (length 17½ inches, weight 4 pounds), from whose stomach were taken 8 miller's thumbs, *Cottus asper,* ranging in length from 3 to 4½ inches."

1968. The sockeye salmon, *Oncorhynchus nerka.* Bulletin of the Fisheries Research Board of Canada, No. 162. 422 pp.

This bulletin presents information on the predator-prey relationship between Dolly Varden and young sockeye salmon.

**Foerster, R. E. and W. E. Ricker**

1942. The effect of reduction of predaceous fish on survival of young sockeye salmon at Cultus Lake. Journal of the Fisheries Research Board of Canada, 5(4): 315-336.

"By persistent gill-netting in Cultus Lake, British Columbia, the predaceous fish which feed on young sockeye (*Oncorhynchus nerka*) have been considerably, though evenly, reduced in numbers. The populations of squawfish and char, of length greater than 200 millimetres, were reduced in three years to about 1/10 of their original numbers. The abundance of trout and coho salmon have been much less affected by netting, if at all, though a considerable number have been killed. From the first year of control operations the survival rate of young sockeye salmon was considerably increased. In the three years which have been tested, the mean survival rate has been increased three and a third times over average conditions prior to control. In absolute figures, this represents 3,800,000 migrants saved, which are expected to yield 380,000 adult sockeye. Even disregarding the important cumulative future increase, the immediate return from the work is a quantity of sockeye whose value is many times greater than the cost of control work."

This article contains limited information on the length frequencies of



Dolly Varden and their distribution within the lake.

**Foskett, D. R.**

1947. Lakes of the Skeena River Drainage. VI. The lakes of the upper Sustut River. Fisheries Research Board of Canada. Progress reports of the Pacific Coast stations No. 72, pp.28-32.

Mentions catching Dolly Varden up to 6 pounds in Sustut Lake and mature Dolly Varden between 6 and 8 inches in Johanson Lake.

**Gaffney, John J.**

1956. A survey of the fishery resource in a section of the Clark Fork River in Western Montana. Montana Fish and Game Department, 12 pp.

Presents information on the sport catch of Dolly Varden and gill-net sampling of Dolly Varden from the Clark Fork River and Cabinet Gorge Reservoir.

**Gard, Richard and Benson Drucker**

1963. Red salmon studies at Karluk Lake, 1962. Bureau of Commercial Fisheries, Biological Laboratory, Auke Bay, Alaska; Manuscript Report Series 63-7; 44 pp.

"Dolly Varden (*Salvelinus malma*) were commonly seen interspersed with schools of outmigrants. No predation or spooking by the Dolly Varden was noticed.

"During one observation period (2045 to 2115 hours on May 25, 1962) large numbers of smolts were seen swimming into the lake along shore areas. These schools were also mixed with adult Dolly Varden, but no predation was seen.

"All smolts faced upstream except when moving laterally across the weir face. Schools of Dolly Varden were commonly seen in great numbers among schools of smolts displaying the same behavior pattern."

**Gibson, H. R. and D. W. Chapman**

1967. Effects of Zectran Insecticide on aquatic organisms in Bear Valley Creek, Idaho. Idaho Cooperative Fishery Unit, University or Idaho. Moscow, 41pp.

Dolly Varden, native to the upper Lemhi River Drainage, were the principal test fish along with a few cutthroat trout and a fresh water sculpin. Age, condition factor, movements and relative abundance of these native fish are discussed briefly.

**Gilbert, Charles H.**

1895. The ichthyological collections of the steamer "Albatross" during the years 1890 and 1891. Report of the United States Commissioner of Fish and Fisheries for the fiscal year ending June 30, 1893. pp. 393-476.

"The Dolly Varden trout was found to be very abundant in the neighborhood of Unalaska, sea-run individuals congregating in great numbers at the mouths and in the lower course of streams when the salmon were running in to spawn. A small stream entering Captain's Harbor, Unalaska Island, has a series of impassable cascades aggregating several hundred feet in height. Above these falls the trout are very abundant, but are dwarfed in size and remarkably brilliant in coloration. They seem to reach no larger size than 8 inches. The largest individual seen during the season was captured in Makushin Bay, Unalaska Island, August 17. It was 24 inches long, with a depth of 6 inches, and weighed 6 pounds. The species was also seined in salt water in Chernoffski Harbor, Unalaska Island."

**Gilbert, Charles H. and C. V. Burke**

1910. Fishes from Bering Sea and Kamchatka. Bulletin of the U.S. Bureau of Fisheries, 30:33-96.

Regarding Dolly Varden distribution, the bulletin mentions that "*Salvelinus malma* (Walbaum) are found on Unalaska, Atka, Agattu, Attu and

Medni Islands, and in Avatcha Bay. Kamchatka."

**Gilbert, Charles H., and Barton W. Evermann**

1894. A report upon investigations in the Columbia River Basin, with descriptions of four new species of fishes. Bulletin of the U.S. bureau of Fisheries, 14:169-204.

This report discusses the distribution of the Dolly Varden within the Columbia River Drainage.

**Girard, Charles**

1857. Notice upon the species of the genus *Salmo* of authors, observed chiefly in Oregon and California. Proceedings, Academy of Natural Sciences of Philadelphia, 8, 1856: 217-220.

The original description of *Salmo malma spectabilis* (Girard) reads as follows:

"3. SALMO SPECTABILIS, Girard-Body subfusiform in profile, very much compressed, the head forming about the fourth of the total length. Maxillary bone curved, extending to a vertical line passing somewhat posteriorly to the entire orbit. Anterior margin of dorsal fin, a little nearer the extremity of the snout than the base of the caudal. Bluish grey above; silvery beneath. Dorsal region and upper portion of the flanks spread over with light spots.

"By its general appearance, this species resembles *Salmo hoodii* most, but may readily be distinguished from it by a more elongated and elliptical head, hence a mouth more deeply cleft, with the maxillary extending further back.

"Specimens collected at St. Mary's Mission, Flathead Valley, Oregon, by Dr. Geo. Suckley, U.S.A., under Gov. I. I. Stevens."

**Godfrey, H.**

1955. On the ecology of Skeena River whitefishes *Coregonus* and *Prosopium*. Journal of the Fisheries Research Board of Canada. 12(4):499-542.

Presents information on the stomach content of 41 Dolly Varden from Lakelse Lake.

"Only a few char [Dolly Varden] have been netted in Lakelse Lake and none in Babine or Morrison Lakes. The char had fed mostly upon small fishes, with only small quantities of bottom insect material or other organisms important in the whitefishes' diet."

**Goode, G. Brown**

1887. American Fishes. Published by Estes and Lauriat, Boston. 496 pp.

On pages 475-476 there is a section on "The Malma Trout" which contains early names and a description.

**Goode, G. Brown and Theodore Gill**

1903. American Fishes. Published by L. C. Page and Company, Boston. 562 pp.

On pages 462-480 there is a chapter on chars which contains information on Dolly Varden similar to that contained in Goode (1887).

**Gordon, C. E.**

1954. Pacific Salmons, Trouts and Freshwater Fishes. Published by MS Press, Portland, Oregon, 70 pp.

Briefly describes Dolly Varden.

**Greenbank, John**

1954. Sport fish survey, Katmai National Monument, Alaska. Game Fish Investigations of Alaska. Quarterly Progress Report, Federal Aid in Fish Restoration Project F-1-R-4. Alaska Game Commission, 4(2):1-32.

Presents information on the distribution of Dolly Varden in the Katmai National Monument with some reference to fishing effort and catch.



**Greenbank, John and Phillip R. Nelson**

1959. Life history of the threespine stickleback *Gasterosteus aculeatus* Linnaeus, in Karluk Lake and Bare Lake, Kodiak Island, Alaska. U.S. Fish and Wildlife Service, Fishery Bulletin, 59(153):537-559.

"The Dolly Varden char (*Salvelinus malma*) is said by Morton not to utilize sticklebacks in Karluk Lake. Of 60 stomachs of Dolly Varden taken in Bare Lake in the period June-August 1956, only 3 contained sticklebacks."

**Gretz, Gordon H.**

1964. Salmonoid rearing and migration study: Fire Lake system. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1963-1964, Project F-5-R-5, Vol. 5, pp. 189 - 204.

Information is presented on the numbers, timing and length frequencies of downstream and upstream migrating Dolly Varden in Fire Creek in 1963.

**Grosvenor, Melville H. and others**

1965. Wondrous World of Fishes. National Geographic Society, Washington, D.C. 20036. 366 pp.

On page 256 is an illustration and description of the Dolly Varden trout.

**Gunther, Albert**

1866. Catalogue of the Fishes in the British Museum. VI. pp. 123-155.

Early description of Dolly Varden.

**Gusev, A. V.**

1951. Paraziticheskie Copepoda s nekotorykh morskikh ryb (Parasitic Copepods of Several Marine Fishes).—Parazitologicheskii Sbornik, 13:394-463, 50 bibliogr. ref. 1951. Taken from Romanov (1966). Abst. No. 2178.

"Description of 34 species of copepods, collected from fishes in Peter the Great Bay in 1937, and from the waters washing Southern Sakhalin, in 1946; of these species, 27 are recorded for the first time in USSR waters."

Mentions *S. malma curilus*.

**Haig-Brown, Roderick L.**

1947. The western angler—an account of Pacific salmon and western trout in British Columbia. William Morrow and Co., New York. 356 pp.

Limited information on the habits of Dolly Varden and a general description of the species are given.

**Haley, Richard**

1962. Inventory and cataloging of the sport fish and sport fish waters on the Kenai Peninsula and Prince William Sound. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1961 - 1962, Project F-5-R-3, Vol. 3, pp. 41-56.

This report contains information on gill-net catch, length and weight of Dolly Varden from several lakes in Alaska. Limited information on the food of Dolly Varden is presented.

**Halkett, Andrew**

1913. Checklist of fishes of the Dominion of Canada and Newfoundland. Ottawa. 138 pp., 14 pl. Published by C. H. Parmelee.

"101. *Salvelinus parkei*. Ranges from California embracing B.C., northward to Aleutians and Herschel Island, Beaufort Sea, Arctic Ocean (Scofield, 1899); and extending westward to the South Saskatchewan and Montana."

**Hanavan, M. G. and G. K. Tanonaka**

1959. Experimental fishing to determine distribution of salmon in North Pacific Ocean and Bering Sea, 1956. U.S. Fish and Wildlife Service, Special Scientific Report — Fisheries No. 302, 22 pp.

Dolly Varden were reported from the following locations: 59°00′ Lat. N. 165°00′ Long. W. (6/13-6/14/56); 59 36′ Lat. N. 167° 27′ Long. W. (8/4-8/5/56); 58°56′ Lat. N. 165°12′ Long. W. (8/5-8/6/56); 58°00′ Lat. N. 159 57′ Long. W. (8/8-8/9/56); 56°57′ Lat. N. 160°04′ Long. W. (8/10-8/11/56); 57°04′ Lat. N. 164°58′ Long. W. (8/12-8/13/56); and 58°00′ Lat. N. 180°00′ Long. W. (7/10-7/11/56).

**Hanzel, Delano A.**

1961. The distribution of the cutthroat trout (*Salmo clarki*) in Montana. Proceedings of the Montana Academy of Sciences, 19:32-71.

Includes information on the distribution of Dolly Varden in Montana.

1962. Survey of cutthroat and Dolly Varden trout in Flathead River and tributaries above Flathead Lake. Job Completion Report. Federal Aid in Fish Restoration. Project F-7-R-11, Montana Fish and Game Department, 6 pp.

"A crew of four men was employed to capture, tag and release Dolly Varden and cutthroat trout in the 171 miles of the Flathead River Drainage above Flathead Lake. Catch rate for tagged fish was 1.8 fish per hour per man (including float time). The average size of the cutthroat trout tagged averaged 9.0 inches, with a range from 7 to 17 inches. A total of 1,175 cutthroat and 216 Dolly Varden have been tagged and released in the river system.

"Recapture information was received on 62 (8.5 percent) wild cutthroat trout and 8 Dolly Varden trout. Seventy-five percent of the recapture information was returned by interested fishermen through letters, by phone or personal contact.

"Movement patterns were indicated; however, another summer's project is necessary before the complete movements of the cutthroat trout in the Flathead River Drainage can be formulated."

1963. Survey of cutthroat and Dolly Varden trout in Flathead River and tributaries above Flathead Lake. Job Completion Report, Federal Aid in Fish Restoration, Project F-7-R-12, Montana Fish and Game Department, 6 pp.

"A crew of four men was employed to capture, tag and release Dolly Varden and cutthroat trout in the 171 miles of the Flathead River Drainage above Flathead Lake. Catch rate for tagged fish was 1.6 fish per hour per man (including float time). The average size of the cutthroat trout tagged averaged 9.0 inches, with a range from 7 to 16.5 inches. A total of 1,676 wild cutthroat trout and 297 Dolly Varden were tagged and released in the river system in 1961 and 1962.

"Recapture information was received on 183 (10.9 percent) wild cutthroat trout, and 33 (11.1 percent) Dolly Varden. Planting tagged brood cutthroat trout in the Middle Fork of the Flathead River yielded a 21.1% (103 of 487 fish tagged) return to anglers. Eighty percent of these fish were caught within three days after being planted. No fish were caught after two weeks.

"Movement patterns were indicated, however, another summer's field work is necessary before the complete movements of the cutthroat trout in the Flathead River Drainage can be determined. Another summer's work would provide additional information on recaptures of tagged fish. Also information pertaining to water discharges and temperatures could be correlated to the movement patterns established."

1965. Survey of cutthroat trout and Dolly Varden in the Flathead River and tributaries above Flathead Lake. Job Completion Report, Federal Aid in Fish Restoration, Project F-7-R-13, Montana Fish and Game Department, 8 pp.

"The tagging of cutthroat trout and Dolly Varden was discontinued until techniques are developed to collect the



older and mature fish in Flathead Lake. Major emphasis was placed in the establishment of water quality monitoring stations along the Flathead River.

"Water samples were collected twice a month at three stations on the Flathead River and at the U.S.G.S. gauge station on the South Fork of the Flathead River below Hungry Horse Dam. This water quality data illustrates the difference between water discharged from the bottom of a 500-foot high peaking power dam (without multigated outlet) and water in a free flowing river. These data will also be a basis for determining basic water quality for future industrial development along this river.

"Data were collected on: water temperatures, dissolved oxygen concentration, pH, total alkalinity and specific conductance.

"Discharges (taken at 285 and 325 feet) from the reservoir held water temperatures immediately below the dam near 39° F. throughout the year. The other water criteria measured, below the dam, showed a tempered effect compared to the free flowing water station.

"Twenty-five cutthroat trout and 10 Dolly Varden, tagged during 1961-1963, were recaptured. Time from tagging to recapturing varied from 2-24 months for the cutthroat and from 8 - 33 months for the Dolly Varden.

"The longest movement recorded was for a cutthroat trout which traveled 102 miles downstream. It was tagged on the North Fork River near the Canadian border and was recaptured in Flathead Lake.

"All Dolly Varden recaptures were from fish tagged in Flathead Lake. One return showed an upstream movement of 99 miles in 13 months. This fish was recaptured 44 miles up the Middle Fork of the Flathead River. All other returns were recaptured in Flathead Lake. Tagging results to date show that the Dolly Varden travel the entire shoreline of Flathead Lake. from the Narrows at the north end of the lake to the mouth of the Flathead River at the north end."

1966. Survey of cutthroat trout and Dolly Varden in the Flathead River and tributaries above Flathead Lake. Job Completion Report, Federal Aid in Fish Restoration, Project F-7-R-14, Montana Fish and Game Department, 8 pp.

"Studies of movements of the Dolly Varden have been entirely on mature fish. The three studies indicate that mature Dolly Varden use the two free flowing forks of the Flathead River for spawning. All the data exemplifies an interdependent relationship between the lake and river system. Four of the thirteen recaptures from the Middle Fork (Bear Creek weir — 99 miles above the lake) tagging were recaptured in the lake. Fourteen of twenty-eight recaptures from the North Fork (Trail Creek Weir — 105 miles above the lake) tagging were recaptured in the lake. None of fifty-five returns from fish released in Flathead Lake were caught upstream on their spawning run. Two of the lake tagged fish were recaptured above the weir sites on the Middle and North Fork Rivers. Movements within the lake show constant traveling of the entire shoreline except during the spring, when concentrations occur near the mouths of the Flathead and Swan Rivers.

"Dolly Varden movements within the lake indicate a preference for shoal or shore areas, however in May and June there is a concentration off the Flathead River mouth just prior to migration upstream."

1967. Survey of cutthroat trout and Dolly Varden in the Flathead River and tributaries above Flathead Lake. Job Completion Report, Federal Aid in Fish Restoration, Project F-7-R-15, Montana Fish and Game Department, 9 pp.

"The Flathead River and tributary streams above Flathead Lake provide a nationally important fishery for cut-

throat trout and Dolly Varden. Recruitment of these fish is dependent on spawning areas found over 100 miles upstream from Flathead Lake. The North and Middle Forks of the Flathead River with their tributaries provide the present spawning areas. This is a total of approximately 120 miles of stream. Movements of cutthroat trout and Dolly Varden into these streams have been documented by returns of tagged fish. It is the objective of this investigation to monitor the present water quality of the Flathead River above Flathead Lake in an effort to determine the factors that affect the migration of game fish to their spawning areas."

**Hartman, Wilbur L., William R. Heard and Robert D. Dewey**

1966. Sockeye salmon studies at Brooks Lake biological field station, 1964-1965. U.S. F. & W. S., Bureau of Commercial Fisheries, Biological Laboratory, Auke Bay, Alaska. pp. 1 - 46.

Contains information on the occurrence of Dolly Varden in the various ecological areas of Brooks River.

**Hartman, W. L., C. W. Strickland, and D. T. Hoopes**

1962. Survival and behavior of sockeye salmon fry migrating into Brooks Lake, Alaska. Transactions of the American Fisheries Society, 91(2):133-139.

This report presents data on the stomach contents of 14 Dolly Varden taken in a fry trap.

**Hazzard, A. S.**

1939. Fish and fishing waters in Glacier Park. The Progressive Fish Culturist. No. 46, pp. 1 - 7.

Brief mention of Dolly Varden fishing in Glacier Park, Montana.

**Heckart, Larry and Eugene Roguski**

1966. Inventory and cataloging of the sport fish and sport fish waters in the Interior of Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1965-1966, Project F-5-R-7, Vol. 7, pp. 215 - 229.

Presents the Dolly Varden sport fish catch at the Eielson sport fishing camp on the Unalakleet River in 1963 (1,029), 1964 (806) and 1965 (553).

**Heckart, Larry, Darwin Jones and Robert Baade**

1967a. Saltwater sport fish harvest studies in Southeast Alaska. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1966-1967, Project F-5-R-8, Vol. 8, pp. 15-31.

The number of Dolly Varden censused from 1966 Southeastern Alaska saltwater sport fisheries were recorded as follows, by area: Juneau 34, Sitka 2, Sitka Salmon Derby 4, Ketchikan 3.

In the Petersburg area: 68 Dolly Varden were censused from Blind Slough and the estimated season's catch was 251; 22 Dolly Varden were censused from Petersburg Creek and the estimated season's catch was 145.

1967b. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1966-1967, Vol. 8, pp. 1-13.

"A significant sport fishery is lacking for the resident Dolly Varden because of the difficult access and undesirable size of the fish. The population is badly stunted; the fish average approximately seven inches long."

The above refers to Gen-Gen Lake in Nakwasina Passage approximately 14 miles north of Sitka on Baranof Island.

Niblack Lake (unofficial name) Moira Sound Prince of Wales Island. "Multi-mesh gill nets were set for six net days, and three Dolly Varden were taken."



**Heimer, John T.** 1968.

1965. A supplemental Dolly Varden spawning area. M.S. Thesis, University of Idaho, Moscow 77 pp.

"A study of a supplemental spawning area for Dolly Varden in the Clark Fork River in north Idaho was begun in August, 1964, and terminated in January, 1965. Primary objectives were (1) to determine selection of redd sights by Dolly Varden as related to intragravel dissolved oxygen content and permeability and (2) to estimate the abundance of emerging alevins in the spawing area through assessment of the numbers of spawners. fecundity, and egg to fry survival. Secondary objectives were to study the spawning habits of the Dolly Varden in the spawning area and to determine certain physical and chemical factors associated with the area.

"Fecundity determinations for six fish, ranging in length from 18.5 to 26.0 inches, varied from 2,136 to 6,753 eggs. Correlation between length and egg content was poor.

"Three thousand eggs were fertilized and planted in three locations in the spawning area. Survival of the planted eggs to 61 days after fertilization at each of the three locations was 68, 30, and 10 per cent. Survival to 93 days after fertilization was 40, 0, and 0 per cent. Survival of control eggs to 23, 29, and 61 days after fertilization was 93, 88, and 55 per cent respectively.

"Most of the spawning occurred during the last week in September and the first three weeks in October. Only a small portion of the total spawning area was utilized for spawning but a large amount of redd superimposition occurred.

"The age of 24 fish in the spawning area from which scales were read ranged from four to seven years. Of these, 20 of the 24 were either five or six years old. Length at given age indicated that these fish grew more rapidly than did Dolly Varden from Priest Lakes, Idaho, or Flathead Lake, Montana."

year's run were spawned and reared in some other stream.

"Char spawned in the Eva Creek drainage generally migrated to the ocean in the fourth year of life, with some char migrating as two and three-year-olds. A small sample of spawned-out collected in the Eva Creek drainage in 1963 contained no char under five years of age, indicating initial maturation may occur in the fifth year of life. Growth of juveniles in Eva Creek drainage was very slow.

"Recapture of char tagged in Eva Creek in 1963 yielded information on seasonal growth increments and growth by days-at-sea. Char which were recovered after 141-160 days in saltwater exhibited the maximum growth (by weight) increment.

"Overwintering in Lake Eva in 1962-1963 had profound detrimental effects upon the overall condition factor of the anadromous char, with an over-winter weight loss of over 30 percent in some age groups."

1966. Age and growth of anadromous Dolly Varden char *Salvelinus malma* (Walbaum) in Eva Creek. Baranof Island, Southeastern Alaska. Alaska Department of Fish and Game, Research Report No. 5. 29 pp.

"The age and growth of Dolly Varden were determined from random samples collected at the Eva Creek weir in 1962-1963. Otoliths were used for all age determinations. The youngest migrant char were from age group II, the oldest from age group XI, and the majority from age groups III through V. By sex, the ratio was nearly equal in the young fish with an increase in percent of females in the older age groups. The char from the Eva Creek - Lake system matured by their fifth or sixth year. The majority of the Lake Eva char spend their 0, 1, II and sometimes III years in fresh water and migrate to sea in their third or fourth year of life. During this rearing period their growth was very slow. Growth between the out- and in-migrations at Eva Creek averaged 44 mm and 0.30 pound. Very little growth was exhibited by the char during their winter stay in Lake Eva. The age composition of char entering a lake system and a non-lake system was compared and discussed."

**Henshall, James A.**

1906. A list of the Fishes of Montana with Notes on the Game Fishes. Bulletin University Montana No. 34, Biological Series No. 11, 12 pp.

"The Dolly Varden, or bull trout. sometimes erroneously called "salmon-trout" is the only red-spotted trout native to western waters. It belongs to the same genus as the eastern brook trout. but growth much larger. It is found in Montana only on the Pacific slope in both lakes and streams, growing to twelve or fifteen pounds under favorable conditions. In the streams it is a gamer fish than in lakes, though the larger fish are rather lazy and logy. Compared with its eastern relative it is hardly so vigorous on the rod, when of similar weight, and not quite so good for the table."

**Higgins, Elmer**

1940. Progress in biological inquiries. 1937. Appendix I. Administrative Report No. 30. In: Report of the United States Commissioner of Fisheries for the fiscal year 1938. pp. 1-70.

"In the Karluk experiments chars marked in the Karluk River during their migration to and from the ocean and in Karluk Lake. In the Red River experiments chars were marked during their upstream and downstream migration."

"The information obtained from these experiments to date is as follows:

1. Of the chars marked at Karluk in June as they were migrating to the ocean, over 12 percent were recaptured between July 17 and September 9, while on their return migration upstream. Of the chars marked in the first Red River experiment 18 percent were recaptured between July 12 and August 18 as they were migrating upstream. Thus, an appreciable percentage of the chars which migrated to the ocean in the spring returned to their home-stream in the fall of the same year.
2. Marked chars from the Karluk experiments were recaptured in salmon traps in the vicinity of Uganik Island over 45 miles away from the point of tagging and marked chars from the Red River experiments were recaptured in Uyak Bay over 60 miles from the point of tagging. These data show that after entering the ocean some of the chars wander a considerable distance away from their home stream.
3. That some straying of chars from one stream to another occurs was proven by the recovery of Karluk marked fish and Red River (5 percent of the total recoveries) and Red River marked fish at Karluk (0.6 percent of the total recoveries). Because of differences in fishing regulations, the difference in the amount of straying may not be as great as the figures indicate. Fishing operations are carried on as close to the Karluk River as 100 yards, whereas fishing in prohibited within 1 mile of Red River.
4. These fish grew very slowly during the time spent in the ocean. Although many of the Karluk River and Red River chars attain the same length as red salmon, the latter, when in the ocean, grow approximately 6 centimeters (2 inches) a month during June, July, and August, while data obtained from the marking experiments indicate that the chars grow only about one centimeter a month during this period. Hence, it appears that these fish have a relatively long life span, a supposition which is, in a measure, confirmed by the otolith readings.

"Both scales and otoliths have been examined and it has been found that the scales are virtually useless as a means of age determination, and that the otoliths, while of some value, are not altogether satisfactory. This difficulty makes the study of the life history much more complicated and other methods of age determination are being tried.

"At Karluk Lake it as noted that chars take a very heavy toll of red salmon fry in the spring at the time the young fish are entering the lake from the spawning streams. However, during the summer and fall relatively little damage is done to the salmon populations by these chars. They have been caught by means of seines and gill nets, and only rarely was one found that had been feeding on salmon fingerlings. Although salmon eggs do comprise a large part of the diet of these fish, it was noted that the chars were feeding almost entirely on floating eggs displaced by the spawning activities of the salmon and these eggs would die whether they were eaten or not. An analysis of stomach contents of chars in Karluk River showed that the chars in the river were not feeding on seaward migrants."

**Hikita, Toyohika**

1962. On the sea-runs char, *Salvelinus malma* (Walbaum) taken from an eastern stream of Hokkaido Island. (In Japanese). Scientific Reports of the Hokkaido Fish Hatchery, No. 17, pp. 59-63.

**Hoffman, Glenn L.**

1967. Parasites of North American freshwater fishes. University of California Press, Berkeley and Los Angeles, 486 pp.

Lists the parasites known to occur in Dolly Varden.

**Holland, Dan**

1939. Alaska Calls, Field & Stream, June 44(2):19-21.

Sport Fishing for Dolly Varden in Alaska with Ford, MacBain and Dufresne. Feels the Dolly Varden is a fine sports fish; compares favorably with Eastern Brook Trout.

**Holloway, Ancil D.**

1945. Results of Fish Planting and a Stocking Plan for Glacier National Park. Typewritten manuscript submitted to Director of U.S. Fish and Wildlife Service January 15, 1945. 18 pp.

"This trout (Dolly Varden) is classed by most fishermen as undesireable because of the predaceous feeding habits and its poor eating qualities. Its contribution to the fishing on the west side of the Park, however, is important because of its large size and occurrence in moderate numbers. Its population is being maintained without the help of hatchery stock. This trout occurs in most of the waters in the park not blocked by barriers except those of the Missouri River System."

Condition factors of Dolly Varden from four west side lakes are presented in Table 5 with the following note: "Except for Dolly Varden, condition factors were high in all Park waters. The number of this species taken was small. As shown in Table 5, those from Bowman Lake were in rather poor condition with an average condition factor of 66. This was the only water in which poor-conditioned Dolly Vardens were taken. Nearly all these fish examined were parasitized with round worms as would be expected, but there appeared to be no correlation between the number of parasites and the condition of the fish. In contrast to the poor condition of the Dolly Vardens in Bowman Lake, the cutthroats had a uniformly high condition factor."

**Hoopes, David T.**

1959. Dolly Varden trout with two adipose fins. Transactions of the American Fisheries Society, 88-(1):73.

"The second adipose fin was situated slightly laterally (right side) and immediately posteriorly to the normal fin. The configuration of both fins was quite similar and each fin appeared to be normal in every respect."

**Hout, Jerry L.**

1960. A method of enumerating the red salmon escapement into the Kenai River. Bureau of Commercial Fisheries, Alaska Region. Gulf of Alaska Salmon Investigations, Field Operation Report, July through September, 1959. 11 pp.

Presents the daily catch of Dolly Varden in the Kenai River index traps in 1959.

**Hubbs, Carl L.**

1940. Predator control in relation to fish management in Alaska. Transactions of the 5th North American Wildlife Conference. pp. 153 - 162.

Destruction of Dolly Varden in Alaska. First published notice that many other species of trout and salmon tails were appearing in the trout "rings" being accepted for bounty payment.

**Huston, Joe E.**

1965. Investigation of two Clark Fork River hydroelectrical impoundments. Proceedings of the Montana Academy of Sciences, 25: 20-40.

Presents information on the Dolly Varden spawning areas, sport catch, age and growth.

**Inamura, Akio and Morizumi Nakamura**

1962. Distribution and variation of fishes in the Genus *Salvelinus* in in Japan. Misc. Rept. Res. Inst. Nat. Resour. Nos. 58-59, pp. 64-78. 2 pl. (In Japanese, with Eng. sum.)

Contains information on the distribution of Dolly Varden in Japan.

**Ishida, Juro**

1942. *Salvelinus* in southern Saghalien (1) and (2). Zool. Mag. 54(9 and 11):347-353 and 431-438, Pls. 2 and 2.



**Jeppson, Paul**

1956. Evaluation of spawning areas in Lake Pend Oreille and tributaries upstream from Albeni Falls Dam in Idaho, June 1, 1955 to May 31, 1956. Annual summary report, Federal Aid to Fish Restoration, Projects F-3-R-5 and F-3-R-6, Idaho, 11 pp.

This paper deals mostly with kokanee; however, some limited observations on Dolly Varden spawners are noted.

1960a. Biological and economic survey of fisheries resources in Lake Pend Oreille. Annual Report for 1959, Federal Aid to Fish Restoration, Project F-3-R-9, Idaho, 36 pp.

"The 1959 creel census at Pend Oreille Lake was designed to determine the size and quality of the annual fish harvest and to establish the catch of resident, non-resident, and commercial fishermen. The stratified sample was nearly 10 per cent of the number of fishermen using the lake."

The total estimated utilization of resident and non-resident sport fishermen and all fishermen and their catch of Dolly Varden in Lake Pend Oreille, Idaho, 1959, is presented. Fishing methods, pressure and best fishing areas are discussed.

1960b. Evaluation of kokanee and trout spawning areas in Pend Oreille Lake and tributary streams. In "Biological and Economic Survey of Fishery Resources in Lake Pend Oreille." Final Report, Federal Aid to Fish Restoration, Project F-3-R-10, Idaho Department of Fish and Game, pp. 43-66.

"The annual spawning migration of Dolly Varden begins in the larger tributaries (Clark Fork River, Pack River, and Lightning Creek) during the runoff period, although spawning does not occur until the fall months. During the summer, Dolly Varden are concentrated below Cabinet Gorge Dam, in pools of the larger tributaries. and in the lake near the mouths of streams. They are not usually observed in the smaller tributaries of the lake before mid-August. Very little feeding occurs during the extended migration period, the fish existing on fats stored during their sojourn in the lake.

"Young Dolly Varden usually remain in the tributary streams for about two years. Large numbers of 6- to 10-inch Dolly Varden are taken by fishermen from the tributaries and backwaters of the lake. Growth in the lake is phenomenal — 20 to 35-inch Dolly Varden re-entering the tributaries on their spawning migration after spending one to three years in the lake.

"Despite regulations designed to protect Dolly Varden during their stream existence, the major harvest occurs during that period.

"Dolly Varden are native to the lake and formerly used many miles of spawning streams in Montana, but migration has been blocked by Cabinet Gorge Dam since 1951. Large numbers use the river each year; 114 large Dolly Varden were counted along 100 yards of the south bank below Cabinet Gorge Dam on October 16, 1960."

1962. Biological and economic survey of fishery resources in Lake Pend Oreille. Idaho Department of Fish and Game, Annual report for 1961. 36 pp.

The total estimated utilization of resident and non-resident sport fishermen and all fishermen and their catch of Dolly Varden in Lake Pend Oreille, Idaho, 1961 is included. Information is presented on the length fequencies of the catch.

1963a. Biological and economic survey of fisheries resources in Lake Pend Oreille. Idaho Department of Fish and Game. Annual report for 1962. 37 pp.

"A creel census has been conducted at Pend Oreille Lake since 1951 by the Idaho Fish and Game Department. Purposes of the 12-year cen-

sus are (1) to determine the size and quality of the catch of fish coincident with the construction and operation of Cabinet Gorge Dam on the major tributary and Albeni Falls Dam on the outlet and (2) to gather vital information to be used in management of the fishery."

Concerning Dolly Varden, data are presented on the total estimated utilization of resident and non-resident sport fishermen and all fishermen and their catch in Lake Pend Oreille, Idaho 1962. Some information is presented on the length frequencies of the catch.

1963b. Pend Oreille Lake Kokanee. Idaho Wildlife Review 16(3):8-11.

"Although small Dolly Varden have been observed to prey upon kokanee fry in nursery streams, kokanee do not make up an important part of the Dolly Varden diet in the lake until a length of 13 inches is reached by Dolly Varden. Kokanee comprise about 50 percent of the diet of 13-inch Dolly Varden, increasing in importance to become almost the sole food of Dolly Varden over 30 inches in length."

**Jeppson, Paul W. and William S. Platts**

1959. Ecology and control of the Columbia squawfish in northern Idaho Lakes. Transactions of the American Fisheries Society, 88 (3):197-202.

Information is presented on the stomach content of 25 Dolly Varden from Pend Oreille Lake, Idaho, Dolly Varden fed mostly on Kokanee, *Oncorhynchus nerka.*

**Jones, Darwin E.**

1966. Salmonoid rearing and migration study: Fire Lake System. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1965-1966, Project F-5-R-7, Vol. 7, pp. 131-144.

Presents information on the numbers and timing of Dolly Varden captured in the weir traps at the Fire Lake system.

**Jones, E. Lester**

1914. Report of Alaska Investigations. Department of Commerce. Bureau of Fisheries. Washington Government Printing Office. 155 pp.

This report presents a brief discussion of the food value of Dolly Varden and commercial operations on this species in Alaska.

**Jordan, David Starr**

1878. Notes on a collection of Fishes from the Clackamas River, Oregon. Proceedings of the U.S. National Museum 1878 Vol. 1:69-85.

Presents an excellent history of the development of the genus *Salvelinus* and gives relative ratios of body parts of *bairdii, fontinalis, oquassa,* and *spectabilis.*

1884. The Dolly Varden trout—*Salvelinus malma.* In: The Fisheries and Fishery Industries of the United States, Section I—Natural history of useful aquatic animals—Part III — Fishes — Prepared by G. Brown Goode, pp. 504-505.

"This species is known in the mountains as 'Lake Trout,' 'Bull Trout,' 'Speckled Trout,' and 'Red-spotted Trout.' In the ocean where it is found in large numbers, it is the 'Salmon Trout.' In the Sacramento the name 'Dolly Varden' was given to it by the landlady at a hotel, and this name it still retains in that region. As none of the other names are distinctive, this one may well be adopted. In Siberia it was formerly known as the 'Malma,' or 'Golet.' The Indian name 'Chewagh' is ascribed to it in British Columbia. In size this species reaches a weight of fourteen pounds. The largest I have seen weighed twelve pounds, which weight is not uncommon in the ocean. In the lakes it averages smaller, and in the mountain



streams it breeds at a length of six or eight inches. In all these peculiarities it agrees with its near relative, the common Brook Trout of the Atlantic coast. It ranges from the upper waters of the Sacramento to Kamtchatka on the west side of the Rocky Mountain chain, and for the most part in and west of the Cascade range. From Puget Sound northward it is generally abundant. It feeds voraciously in the salt water on smelt of various sorts. young Trout, sand lances, shrimps, anchovies, herrings, and even sticklebacks. In fresh waters it probably eats whatever living thing it can get. Nothing is certainly known of their breeding habits. They probably spawn late in the fall in the rivers, and therefore those which are in the sea must be to some extent migratory. They are taken in Frazer River at the time of the eulachon run, but they probably then ascend the river to feed upon the eulachon, and not for spawning purposes. As a food-fish this beautiful species ranks high."

887. The fisheries of the Pacific Coast. In: The fisheries and fishery industries of the United States, Section II, a geographical review of fisheries industries and fishing communities for the year 1880, prepared by George Brown Goode. pp. 591-630.

Jordan mentions that *Salvelinus malma* abound in salt water near the Puyallup River in Commencement Bay (Washington) and reach a weight of 12 or 14 pounds. Also many Indians bring in boat loads of salmon trout (*Salvelinus*) almost daily to the Seattle market.

8. On the Occurrence of the Great Lakes Trout (*Salvelinus namaycush*) in British Columbia waters. Proceedings U.S. National Museum, Vol. XI p. 58.

*S. malma* collected east of Rockies south Saskatchewan River.

Salmon and Trout of the Pacific Coast — In California Board of Fish Commissioners Biennial Report for 1893-94, No. 13 pp. 125-141.

Good account of derivation of name Dolly Varden on p. 128-129.

1905a. A Guide to the Study of Fishes Vol. II Henry Holt & Co., N.Y.

Descriptions of *S. malma* and *spectabilis* on p. 114.

1905b. Notes on the Salmon and Trout of Japan. Annotations zoological Japonenses 3:161-162, Tokyo. In proceedings U.S. National Museum 28:365-6.

The distribution of Dolly Varden in Japan.

1907. The Trout and Salmon of the Pacific Coast. Nineteenth Biennial Report of the State Board of Fish Commissioners of the State of California for the years 1905-1906. Sacramento, 1907. 112 pp.

"The Pacific slope has one char, the *Malma,* or Dolly Varden, known in science as *Salvelinus malma.* In 1878, when the present writer first tried to classify these Western trout, a specimen of this *malma* was sent in from the Upper Soda Springs, on the Sacramento River, near the foot of Mount Shasta. The landlady at the Soda Springs said of it: 'Why, that is a regular Dolly Varden!' So Professor Baird said to me: 'Why not call it Dolly Varden trout?' And Dolly Varden trout it has remained to this day.

"As it appears in the rivers, the Dolly Varden is one of the most beautiful of all trout. Dark steel-blue above, with round spots of crimson on its sides and over its back, while its fins are trimmed in front, as in chars generally, with crimson and white. The Dolly Varden is found in the McCloud and other tributaries of the Upper Sacramento. It is more plentiful in the Upper Columbia, always in cold, clear waters. It is still more abundant in all the shorewise streams of Alaska and across the Aleutian Islands to the coast of Kamchatka, and it is equally plentiful in northern Japan. From Pu-

get Sound northward it runs down to the sea, where it loses its spots and becomes nearly plain silver-gray. In Alaska it is called Salmon trout; in Washington, Bull trout, but the name Dolly Varden can be used anywhere.

"Its size depends on its food. It may weigh, when mature anywhere from six ounces to twelve pounds. The little ones are brightest in color. In the little brook which falls into Captain's Harbor at Unalaska are multitudes of bright little Dolly Vardens, mature at six inches. In the harbor below the falls are plenty of sea-run fishes of the same sort weighing ten pounds. In Kodiak the Dolly Varden is caught in the seine by the ton and thrown away by the salmon fishermen.

"The Dolly Varden is much more voracious than the true trout. In Alaska streams they devour millions of salmon eggs, as well as young salmon. It is the greatest enemy the salmon breeder finds. It is gamy and vigorous, takes the hook freely, with a fly, an insect, a salmon egg or a scarlet petal from some mountain flower.

"It is a good food fish. All trout are that; some perhaps better, but I cannot see much choice. In Kamchatka the Dolly Varden is baked in pies, 'deep pies,' like those sold in English eating houses, and in that form they are surely good. To the trout-hog the Dolly Varden can be strongly commended, for it swarms in millions in every Alaska stream (the Yukon and its tributaries excepted). It will take the hook cheerfully, even dutifully. I once saw two Dolly Vardens caught with a pin-hook, which a little girl let down through a knot hole into the gutter on a street in Skagway. And of the thousands there is not one that would ever be missed, for each one which is killed saves the lives of dozens of salmon."

1922. The Days of a Man — being the memories of a naturalist, teacher, and minor prophet of democracy. Volume One 1851-1899 pub. by World Book Company, Yonkers-on-Hudson, New York. 710 pp.

"Another fine form with bright crimson spots — *Salvelinus malma* — had been sent to Washington from the upper Sacramento, with the comment that the landlady at Upper Soda Springs declared it looked 'like a regular Dolly Varden.' This likeness to the 'plump coquettish little minx' of Dickens 'Barnaby Rudge' pleased Baird, and he remarked: 'That's a good name; call it Dolly Varden.' And Dolly Varden it remains to this day!"

Mentions areas in Alaska where he has observed Dolly Varden.

1923. The name of the Dolly Varden Trout, *Salvelinus spectabilis* (Girard) Copeia. No. 121, pp. 85-86.

"The Dolly Varden Trout or Bull Trout, the char of northern California and northward has, so far as observation goes, the head longer than in the red-spotted char of Alaska *Salv. malma* (Walb.). In the Columbia River examples, the head is more than one-fourth the standard length (to base of caudal); in Alaska examples, less than one-fourth.

"The earliest scientific name of the Dolly Varden is *Salmo spectabilis* Girard. This name was set aside by Jordan and Evermann because of the earlier Salar spectabilis, Cuv. & Val. But the two fishes belong to different genera, and the combination *"Salmo spectabilis"* had not been used before Girard. If the species is distinct from *Salvelinus malma*, the name *Salvelinus spectabilis* must stand, replacing *Salvelinus parkei*."

1925. Fishes. D. Appleton Co., N.Y. 773 pp.

Description of *Salvelinus malma* and *S. spectabilis*.

1928. The distribution of fresh-water fishes. Annual Report of the Smithsonian Institution for 1927. pp. 355-385.

**Jordan, David Starr, and Barton W. Evermann**

1896. Fishes of North America. Part I. Bulletin #47 of U.S. National Museum, Pages 506-517 contain good description of genus and species of *Salvelinus* in America.



1902, 1905, 1925, and 1934. American food and game fishes. Country Life Press, Garden City, N.Y., or Doubleday Page and Co., N.Y.

This book contains a detailed description of the Dolly Varden and limited information of their habits.

**Jordan, David S. and Charles H. Gilbert**

1882a. Synopsis of the fishes of North America. Bulletin of the United States National Museum, No. 16. 1,018 pp.

Contains a description of the Dolly Varden, *Salvelinus malma,* on page 319 and 320 with some notes on their distribution.

1882b. Notes on the Fishes of the Pacific Coast of the United States. Proceedings of the U.S. National Museum, IV:29-70.

"*Salvelinus malma* (Walb) Jordan and Gilbert — Dolly Varden Trout; Bull Trout; Salmon Trout. (*Salmo spectabilis* Girard; *Salmo campbelli* Suckley; *Salmo lordii* Gunther; *Salmo tudes* Cope; *Salmo callarias* Pallas; *Salmo bairdii* Suckley.)

"Abundant in lakes and streams of the Cascade Range from Mount Shasta northward to Alaska. Large numbers are found in the salt waters of Puget Sound where they are taken in seines and with hook and line.

"In the mountains it is usually quite small; in the lakes larger. At Seattle and in the Fraser River it often reaches a weight of twelve pounds. It is an excellent food-fish. It feeds off sticklebacks (salmon killers), herrings and other small fish."

**Jordan, D. S. and C. L. Hubbs**

1925. Records of Fishes Obtained by David Starr Jordan in Japan. 1922. Ext. from Memorial Carnegie Museum, Vol. X. No. 2, pp. 93-346.

Jordan expresses doubt if red-spotted charr or Iwana *Salvelinus pluvius* can be separated from *Salvelinus malma.*

P. 140 Genus *Salvelinus* (Nilsson) Richardson:

"The species of charr found in tributaries of the N. Pacific are very far from final determination. The name *Salvelinus malma* evidently belongs to a northern form, known from Unalaska to Kamchatka. Close to this, but with the head constantly larger, is the 'Dolly Varden' or 'Bull Trout' of Northern California and northward. This may stand as *S. spectabilis* (*parkei*) and probably grades into the preceeding. Both of these enter the sea, growing to a weight of 8-10 pounds the red spots becoming silvery. In all the mountain streams of northern and middle Japan the common trout, or Iwana, *Salvelinus pluvius,* agrees closely with *Salvelinus malma* but its pyloric caeca and gill-rakers average fewer and the spots on the side and back are larger.

"Another group of charr has the pale spots much larger, some as large as the eye, otherwise much like *S. pluvius*. Specimens from Kamchatka (*S. leucomaenis*) have the head short, 4.5-4.66 in length. A related form or species of this type from Hameda in Iwami has the head 4 inches in length and the caeca very few — only 17. This we call *S. imbrius;* granting it, pending study, the rank of a destined species. They present a 'Key to Pacific Species of *Salvelinus; S. spectabilis, malma, pluvius., leucomaenis* and *imbrius*."

On P. 143 is a tabular listing of anatomical characters of five Pacific species of *Salvelinus*.

**Jordan, David Starr and J. O. Snyder**

1902. A review of the Salmonoid Fishes of Japan. Proceedings of the U.S. National Museum 24(1265):567-793. 5 figs.

"In streams of Alaska and Kam-

chatka descending to the sea, very abundant throughout the Aleutian region and extending its range through the Kuriles to the Okhotsk Sea. Probably *S. pluvius* is a southern variety of the species as is the Dolly Varden trout, *Salvelinus parkei* of Washington, Oregon and northern California."

**Jordan, David Starr and Edwin Chapin Starks**

1895. The fishes of Puget Sound. Contributions to biology from the Hopkins Laboratory of Biology III, Leland Stanford Jr. Univ. Pub. pp. 785-855.

Mentions of Dolly Varden: "Abundant. In Puget Sound it is taken from salt water in large numbers. An excellent food fish reaching in salt water a weight of 11 pounds or more. Locally known as bull trout or salmon trout."

**Jordan, D. S., B. W. Evermann and H. W. Clark**

1930. Check-list of fishes and fish-like vertebrates of North and Middle America north of the northern boundary of Venezuela and Columbia. Report of the U.S. Commissioner of Fisheries 1928 pt. 2.

Contains all species of American chars recognized by Jordan just before he passed away.

**Jordan, D. S., Tanaka S. and J. O. Snyder**

1913. A catalogue of the Fishes of Japan Jour. Coll. Soi. Imp. Univ. Tokyo March 31, 1913 — 33(1): 1497.

The occurence of Dolly Varden in Kuriles, Okotsk Sea and Kamchatka.

**Kaganovskii, A. G.**

1955. Golets is basseina Beringova morya (Char from the Basin of the Bering Sea). —Voprosy Ikhtiologii, No. 3:54-56, 3 bibliogr. ref. Taken from Romanov (1966). Abst. No. 2711.

"Description of a new species of char (*Salvelinus taranetzi* Kaganovsky, sp. n.) caught on August 12, 1948 in the Achchen Lake, which connects a small river with the Bering Sea near Providence Bay. Comparative characteristics of the Taranets char and Dolly Varden char."

**Kanid'ev, A. N.**

1966. Stepen'vyzhivaniya molodi kety *Oncorhynchus keta* (Walbaum) v reke [Survival rate of juvenile chum salmon *Oncorhynchus keta* (Walbaum) in rivers.] Vop Ikhtiol, 6(4):708-719; Biological Abstracts, 48(22), Abst. No. 109986, 1967.

"The downstream migration of juvenile chum salmon (*Oncorhynchus keta*) released in the Yasnomorka River continues for more than 1½ mo. Night migration, timidity, feeding by day in shallows, schooling behavior, etc. are characteristics of the juveniles, i.e., all those traits which acterize the behavior of juveniles, of natural spawning during river life. Most deaths of the migrating juvenile chum salmon are caused by the predatory fishes Kundzha (*Salvelinus leucomaenis*), Dolly Varden trout, and cherry salmon (*Oncorhynchus masu*) and by a drop of the river level. The total death of the juvenile chum salmon during the downstream migration period was a bit more than 9%. Greatest damage was inflicted by the kundzha, then the Dolly Varden and cherry salmon. The smallest population of predators during the migration period of the chum salmon was observed at the end of June, and their minimal concentration in the lower reaches of the river. The level of the river is stabilized by the end of the migration period. As a consequence of the identical hydrological regime of rivers and the composition of predators on the southwestern coast of Sakhalin, the magnitude of the death of released juvenile chum salmon is approximately the same as their death in the Yasnomorka River. Taking into account the size of the predators and their number and distribution in time and along the length of the river, migrant juvenile chum salmon for protection, should be grown to larger size and released in the lower reaches of the river at the end of May or beginning of June. —J. Slep."



**Kazarnovskii, M. Ya.**

1962. Food of migrating fry of *Oncorhynchus gorbuscha* and *Salvelinus malma* in the rivers of Sakhalin. (Pitanie pokatnoi molodi gorbushi i mal'mi v rekakh Sakhalina.) Rybnoe Khoz. 38(6):24-25; Biological Abstracts 41(5), Abst. No. 20992. 1963.

"Studies made in 1960 showed that fry of *Oncorhynchus gorbuscha* hardly ate at all in the rivers. Empty stomachs were found in 96.8% of all the specimens examined. The percentage with food in their stomachs was somewhat higher among those migrating into the sea at the end of June to the beginning of July. Larvae of Chironomidae were the chief source of food. Mayfly and caddis fly larvae, water mites, and winged insects were also found. *Salvelinus malma* fry began to feed actively as soon as they emerged from their redds. Empty stomachs were found in only 25.9% of the specimens examined, *S. malma* lived close to the banks and in the stagnant parts of the rivers. The chief sources of food (by weight) for this sp. were winged insects and mayfly and midge larvae. Midge pupae, stone fly larvae, Amphipoda, Crustaceae, and water mites were also found. The average weight of *S. malma* (232 mg) was appreciably higher than that of *O. gorbuscha* (199.4 mg), while their lengths were 30.6 mm and 32 mm, respectively. On the basis of these data, the author concludes that *S. malma* and *O. gorbuscha* do not compete with one another for food in the rivers of Sakhalin. (Marianne Das)"

**Keating, James F.**

1968. Tests for increasing returns of hatchery trout. Idaho Fish and Game Department. Job Completion Report. Federal Aid to Fish Restoration, Project F 32-R-9. 27 pp.

The sport catch of Dolly Varden taken from the Lochsa River is presented.

**Kemmerer, George, J. R. Bovard and W. R. Boorman**

1924. Northwestern lakes of the United States; biological and chemical Studies with references to possibilities in production of fish. Bulletin of the U.S. Bureau of Fisheries, 49:51-140.

Physical, chemical and biological surveys were made in many northwestern lakes for comparison with each other and to determine their suitability for trout. Dolly Varden were reported to be in Lake Chelan (Washington) and Pend Oreille Lake (Idaho).

**Kincaid, Trevor**

1919. An annotated list of Puget Sound Fishes. State of Washington, Department of Fisheries, Olympia. 51 pp., or Reports No. 30 and 31, State of Washington, State Fisheries Commissioner.

The distribution of Dolly Varden in Puget Sound, Washington.

**Kinnie, Ernest J.**

1960. Fishing Guide to Glacier National Park. Pamphlet Pub. by Gazette Press, Berkeley, California. 32 pp.

Tells where you may catch Dolly Varden or Bull Trout in Glacier National Park.

**Kirkwood, James B.**

1962. Inshore marine and freshwater life history phases of the pink salmon, *Oncorhynchus gorbuscha* (Walbaum), and the chum salmon *O. keta* (Walbaum) in Prince William Sound, Alaska. Ph.D. Thesis, University of Louisville, Kentucky, 300 pp.

with the peak of the outmigration occurring on May 27. High flows during the fall of 1965 negated the weir as a fish barrier and then fish were able to ascend to Bear Lake where they remained during the winter.

"Beginning about September 15 [1966], an undetermined number of Dolly Varden were able to swim over the weir when stream flows greater than 90 cfs flooded the aluminum slat barrier. These fish will spend the winter in Bear Lake and then migrate to sea during June of 1967."

**Lord, J. K.**

1867. A new charr (*Fario lordii*) from British Columbia. Intel. Observ. 10:338-347.

Description of a dwarf form of *malma*.

**MacDonald, Rose M. E.**

1921. An analytical subject bibliography of the publications of the Bureau of Fisheries, 1871 - 1920. Report of the U.S. Commissioner of Fisheries, 1920, App. V. 306 pp.

This compilation lists some early papers which contain limited information on the Dolly Varden.

**Mallet, Jerry L.**

1964. Biological and economic survey of fishery resources in Lake Pend Oreille, the Lake Pend Oreille creel census and life history studies, 1963. Annual Report. State of Idaho Fish and Game Department. pp. 1 - 17.

"Cutthroat trout in the fishery ranged from 6 to 17 inches in total length and averaged 12.1 inches; Dolly Varden from 7 to 34 inches, averaging 20.5 inches; and kamloops rainbow from 7 to 37 inches, averaging 14.6 inches. Approximately 61.5 per cent of the Dolly Varden (682) and 14.1 per cent of the kamloops (1,442) were 'trophy' fish, 17 inches or longer."

1965. Biological and economic survey of fishery resources in Lake Pend Oreille, the Lake Pend Oreille creel census and life history studies, 1964. Annual Report. State of Idaho Fish and Game Department. pp. 1 - 18.

"The catch of Dolly Varden continued to decline, reaching an estimated 929 in 1964, lowest figure on record. This compared to an average of 1,572 for the prior 5-year period. Closing tributaries utilized for spawning to Dolly Varden fishing was initiated during the 1964 season in an effort to stabilize this population."

A sample of 102 Dolly Varden was measured. They ranged in length from 8 to 33 inches, averaging 18.9 inches (0.7 inch smaller than the 5-year average). Approximately 52.9 per cent of the Dolly Varden were "trophy" fish, 17 inches or longer.

1966a. Biological and economic survey of fishery resources in Lake Pend Oreille; the Lake Pend Oreille creel census and life history studies, 1965. Annual Report. State of Idaho Fish and Game Department. pp. 1 - 18.

"The catch of Dolly Varden in 1965, although still considerably below the harvest for the early portion of the creel census program, was nevertheless the highest since 1960 with a total of 1,460 taken. However, average size was down 1.7 inches from the five-year average (17.8 inches as compared to an average of 19.5 inches). The actual number of "trophy-size" fish compared favorably with that of previous years but the percentage of the Dolly Varden that were trophy fish was the lowest recorded. This reveals the fact that the increased 1965 Dolly Varden harvest was a result of more small Dolly Varden entering the creel.

"The increase in the catch of Dolly Varden may be merely due to natural population fluctuations or may be the first results of the stream closures on major Dolly Varden spawning grounds. Certainly no increase can be allocated to increased reproduction of Dolly Varden in tributary streams due to the closure since it has only been in effect since the 1964 fishing season. However, the effect of this measure may be felt in that there is no longer exploitation of the juvenile Dolly Varden that spend the first portion of their life in the streams, thus causing an increased flow of younger fish to the lake. In addition, it is typical for a portion of the Dolly Varden from the lake to move into streams throughout the summer with spawning fish although they are not yet ready to spawn themselves. The closure also gives protection to this portion of the population and this possibly may be of a sufficient magnitude to be reflected in the catch. Any reasons given for this increased Dolly Varden catch at the present time are, of course, supposition and the only real conclusions that may be drawn will be after the harvest for the next few seasons has been reviewed."

1966b. Biological and economic survey of fishery resources in Lake Pend Oreille; the Lake Pend Oreille creel census and life history studies, long term trends. Annual Report, State of Idaho Fish and Game Department. pp. 19 - 42.

"Dolly Varden was found to be an abundant species in Lake Pend Oreille during the early census program. However, the annual harvest has decreased in recent years (Figure 7). Catch has varied from a low of 929 in 1964 to a high of 5,035 in 1953 with an average catch of 2,245 (Table 6).

"The blockage of the Clark Fork River by Cabinet Gorge Dam and resultant loss of many miles of spawning grounds appears to have been the major cause of the decline in Dolly Varden numbers. In an effort to provide spawning grounds as replacement for a portion of the lost area, the Washington Water Power Company constructed an artificial spawning bed downstream from Cabinet Gorge Dam in 1960 and 1961. An estimated 20 to 30 female Dolly Varden were estimated to have used the area in 1964 (Heimer, 1965). Fishing for Dolly Varden in streams tributary to Pend Oreille Lake was curtailed in 1964 and has been in force since as an added measure to try and restore the Dolly Varden population to a relatively high level."

1967. Biological and economic survey of fishery resources in Lake Pend Oreille. The Lake Pend Oreille creel census and life history studies, 1966.

"Cutthroat trout in the fishery ranged from 8 to 17.5 inches in total length and averaged 12.2 inches; Dolly Varden from 11 to 32½ inches, averaging 18.6 inches; and Kamloops rainbow from 6½ to 35 inches, averaging 14.6 inches. Approximately 61.7 per cent of the Dolly Varden (740) and 20.9 per cent of the Kamloops 1,040 were 'trophy' fish, 17 inches or longer."

1968. Biological and economic survey of fishery resources in Lake Pend Oreille. The Lake Pend Oreille creel census and life history studies, 1967. Idaho Fish and Game Department, Annual Report, 18 pp.

"The catch of Dolly Varden in 1967 was the lowest on record, 657."

"Dolly Varden ranged from 9 to 33 inches, averaging 18.6 inches . . ."

**Margolis, L.**

1967. The swimbladder nematodes (Cystidicolinae) of Pacific salmons (Genus *Oncorhynchus*). Canadian Journal of Zoology 45(6):1183-1199.

The occurrence of the nematode *Salvelinema salmonicola* in Dolly Varden.

**Marriott, Richard**

1965. Inventory and cataloging of the sport fish and sport fish waters of Southwest Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1964 - 1965. Project F-5-R-6, Vol. 6, pp. 97-110.

"Dolly Varden were abundant in the first half mile above tidewater, were mixed with cutthroat trout in the next quarter mile, and were almost absent in the last quarter mile below the falls. Cutthroat trout were present in small numbers near the falls, diminishing progressively downstream to approximately one-half mile below the falls . . . the lowest point that they were observed."

**Mattson, Chester R. and Richard G. Rowland**

1963. Chum salmon studies at Traitors Cove field station, June 1960 to March 1963. Bureau of Commercial Fisheries, Biological Laboratory, Auke Bay, Alaska; Manuscript Report Series 63-11; 32 pp.

"Dolly Varden, next in abundance to salmonids, were definitely migratory in nature. In late July large numbers of Dolly Varden moved upstream from the intertidal areas. Large concentrations observed within several of the large pools made very definite upstream movements. The large pool in section 16 had 300 to 400 Dolly Varden during the first week of August, but they slowly decreased in numbers. One month later an underwater survey of a pool beneath a log jam near the mouth of Coho Creek in section 25 disclosed a concentration of 700 to 800 Dolly Varden. They remained there until mid-September, when the last underwater survey was made. It was presumed they were awaiting maturity and would spawn later in the fall. One Dolly Varden was tagged in section 14, was observed a week later in section 16, and was last seen one month later in section 26."

The stream had been divided into thirty-two 100-yard-long sections extending from the zero tide level upstream to the base of a 15-foot falls.

**McAfee, William R.**

1966. Dolly Varden trout. In: Inland Fisheries Management. Published by the State of California, the Resources Agency, Department of Fish and Game. Alex Calhoun. editor. pp. 271 - 274.

Briefly reviews and lists references on the distribution and life history of the Dolly Varden.

**McCart, P.**

1967. Behaviour and ecology of sockeye salmon fry in the Babine River. Journal of the Fisheries Research Board of Canada. 24(2):375-428.

The results from the examination of three Dolly Varden stomachs is presented, all had been feeding on sockeye salmon fry.

**McDonald, Marshall**

1894. Report on the salmon fisheries of Alaska. Bulletin of the United States Fish Commission for 1892. 12:1-49.

"The Dolly Varden Trout (*Salvelinus malma*).

"This handsome species bears a very close resemblance to the sea trout of Labrador. It is known to commerce under the name of salmon trout. The Russian name of the species is *goletz*, and in Kamchatka it is the *malma*. In western Montana it is known as salmon trout and bull trout, the latter name being current also in California.

"The name dolly varden was in use for it at Soda Springs, California, at least as early as 1872. The McCloud River Indians call it the Wye-dar-deek-it. In the McCloud its weight varies from 2 to 15 pounds. According to Mr. J. B. Campbell—

" 'It frequents the river from the junction (with the Pitt) to the spring, there being none above the spring and few near the river mouth. If one takes hold of the dolly varden it slips away nearly like an eel. The species is very destructive to other trout, or any kind of fish. It spawns in September and November. The eggs are about one-half the size of those of the common (rainbow) trout. The fish are very difficult to obtain. They will live in a small place where the common trout would not. I have kept them in a pond about 6 feet square for a month, where the rainbows would kill themselves in a short time. They appear to be more hardy.

"The average weight of this trout in the sea fishery at Kodiak is about 2-½ pounds. It reaches a length of 30 inches, and individuals weighing 8 pounds are often taken. It increases in size to the northward.

"The dolly varden is a migratory species and passes much of its time in the sea near the river mouths; it enters the rivers late in the fall and descends in the spring. Mr. Washburn says that it arrives at St. Paul in April. It remains in the bay near St. Paul throughout the summer. Mr. Charles Hirsch states that it reaches Karluk in the latter part of May and runs through the whole season. Dolly vardens of a pound or more can be found in the streams at any time during the summer. Mr. E. W. Nelson found them at Unalaska early in June, and in the Yukon in the same month, but he says they are most numerous in the fall just before and after the streams freeze over. They enter the rivers and go up to their headwaters for the purpose of spawning. The spawning season is in winter and may begin very early in this part of the year. A female, opened on the beach at Karluk August 2, 1889, contained eggs which seemed to be nearly ripe.

"Individuals taken at sea sometimes have capelin in their stomachs. In Karluk River, near its mouth, I have seen them feeding on eggs of the red salmon, which had been thrown into the water from the fish-cleaning houses. On the 5th of August I found a female dolly varden with very small ovaries; this example was long and slender. On August 16, a spent or sterile *malma* was found above the rapids in a little stream tributary to Karluk River. At the head of Karluk Lake, August 19, was discovered a very much emaciated trout of this species, which was struggling in the water and nearly dead. The inside of its mouth was full of large lernaean parasites.

"The dolly varden spends the entire summer in salt water near the mouths of the rivers after it has reached a certain age; younger individuals remain in the rivers and lakes. Many thousands of these trout are caught in the seines hauled for salmon, and fisheries exist for this species alone in various localities. It is put up in pickle and sold in San Francisco. The demand there, however, is limited.

"No serious diminution of the supply of this trout has been observed. There is great destruction of the fish, however, at Karluk in the seining for red salmon, where thousands of dolly vardens are taken and left lying unused on the beach. Something should be done to prevent this waste of good fish.' "

**McGinnis, Dan**

1964. Inventory, cataloging and population sampling of the sport fish and sport fish waters of the Cook Inlet drainage. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1963-1964, Project F-5-R-5, Vol. 5, pp. 291-307.

The sport catch of Dolly Varden from some Matanuska Valley Lakes is presented.

1965. Inventory, cataloging and population sampling of the sport fish and sport fish waters of the Cook Inlet drainage. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1964-1965, Project F-5-R-6, Vol. 6, pp. 201-216.

Includes information on the sport catch of Dolly Varden from several Matanuska Valley lakes.

1966. Inventory, cataloging and population sampling of the sport fish and sport fish waters of the Cook Inlet drainage. Alaska Department of Fish and Game. Federal

Aid in Fish Restoration, Annual Report of Progress, 1965 - 1966. Project F-5-R-7, Vol. 7, pp. 155-169.

Present sport fish catch statistics on Dolly Varden caught in some Matanuska Valley lakes.

**McPhail, J. D.**

1961. A systematic study of the *Salvelinus alpinus* complex in North America. Journal of the Fisheries Research Board of Canada, 18-(5):793-816.

"Sympatric populations of *Salvelinus malma* and *Salvelinus alpinus* from Karluk and Fraser Lakes, Kodiak Island, Alaska, were compared using the discriminant function analysis. The analysis indicated that hybridization between *S. malma* and *S. alpinus* rarely if ever, occurs in these lakes. Therefore, *S. malma* and *S. alpinus* are considered distinct species. Data on 507 *S. malma* and 411 *S. alpinus* from 77 localities suggest at least two distinct forms of both *S. malma* and *S. alpinus* in North America. Speculations are made on the origin and evolution of *S. malma* and *S. alpinus*."

**McPhail, J. D. and C. C. Lindsey**

1958. Preliminary list of fish collections in the Institute of Fisheries, from Alaska, Yukon River, and Gulf of Alaska drainages. Institute of Fisheries, University of British Columbia, Vancouver, Canada. 16 pp.

Lists locations where Dolly Varden have been collected in Alaska.

**Meehan, William R.**

1966. Growth and survival of sockeye salmon introduced into Ruth Lake after removal of resident fish populations. U.S. Fish and Wildlife Service, Special Scientific Report —Fisheries No. 532, 18 pp.

Information is presented on the number of Dolly Varden enumerated at the Little Kitoi Lake weir, Afognak Island, Alaska, from 1955 through 1963.

**Meehan, William R. and Donald B. Siniff**

1962. A study of the downstream migration of anadromous fishes in the Taku River, Alaska. Transactions of the American Fisheries Society. 91(4):399-407.

The general downstream migration patterns of juvenile Dolly Varden in the Taku River are presented.

**Metsker, Howard**

1967. Iliamna Lake watershed freshwater commercial fisheries investigation of 1964. Alaska Department of Fish and Game Informational Leaflet No. 95, 50 pp.

Mentions that "Bristol Bay area marks the upper limit of the Dolly Varden range and the lower limit for arctic char. Due to physical similarities of the two species they are grouped as arctic char in this study. Separating the arctic char - Dolly Varden complex under winter field conditions was not considered practical."

Information on the Arctic char-Dolly Varden includes round-dressed weights; length-weight relationships; length and age composition; maturity; condition and flesh color; feeding habits; 1964 catch in Iliamna Lake; fishing areas: fishing effort and fishing interval.

**Miller, R. B.**

1954. Effect of the Pocaterra power development on Lower Kananaskis Lake, Government of the Province of Alberta. Department of Lands and Forests. Fish and Game Branch. pp. 1 - 11.

"Twenty-three Dolly Varden were examined. They ranged in size from 13.3 inches and 13 ounces to 28.3 inches and 10 pounds. Large fish predominated: 13 were over six pounds, 1 over five pounds and 9 were under two pounds."



Scales were used to age the 23 Dolly Varden.

Food was present in 18 stomachs, leeches were the most frequently occurring item.

"The three-year-olds were all immature. One four-year-old appeared to be going to spawn this coming fall. All the older fish were mature. Maturity probably is reached in the fifth summer by some and in the sixth by most."

**Miller, Robert R. and W. M. Morton**

1952. First record of the Dolly Varden, *Salvelinus malma*, from Nevada. Copeia, No. 3, pp. 207 - 208.

This is an account of three Dolly Varden taken from the Jarbidge River, Nevada.

**Miyadi, Denzabro, Kawanabe, Hiroya and Mizuno, Nobuhiko**

1966. Colored illustrations of the freshwater fishes of Japan. (Rev. Ed.) (in Japanese), 275 pp. Hoikusha Book Co., Osaka.

**Moiseev, P. A.**

1936. Sostav ikhtiofauny reki Sedanki v svyazi s postroikoi Vladivostokskogo vodoprovoda. (Composition of the Ichthyofauna of the Sedanka River, in Connection with the Construction of the Vladivostok Water Works). — Vestnik DVFAV SSSR, No. 18:133-140, 7 bibliogr. ref. Taken from Romanov (1966), Abst. No. 1359.

"List of 37 species of fish found in the basin of the Sedanka River, with some data on their biology. Most of the fishes are pure marine species." Includes *S. malma curilus*.

**Mori, Tamezo**

1927. On the fresh-water fishes from the Yalu River, with descriptions of new species. Journal Chosen Natural History Society, Korea 6:8-24.

1928. A catalogue of the Fishes of Korea. Journal Pan-Pacific Research Institute, 3(3)3-8, Honolulu.

The occurrence of *S. malma* in the headwaters of the Yalu River.

1934. On the Geographical Distribution of Korean Salmonidae. Proceedings 5th Pacific Science Congress. Toronto, Canada, 5:3775-3776.

"8. Malma (Walbaum) found along the coast near Seisan."

**Morton, W. M.**

1942. The ecology of two Alaska charrs as shown by their parasites. Master of Science Thesis, University of Washington, Seattle, Washington. 31 pp.

For Dolly Varden, information is given on their parasites; ecology; food and feeding habits; associated species; coloration; timing of migrations; time of spawning; nature of spawning site and age at initial migration to sea.

1965. The taxonomic significance of the kype in American salmonids. Copeia, No. 1, pp. 14 - 19.

"Large adult male salmon that migrate considerable distances from their feeding to their breeding areas have long been known to develop large heads and jaws which often are associated with the development of a pronounced 'hump' in the back just posterior to the head. In the genus *Oncorhynchus*, the upper jaw elongates more than the lower jaw to form a 'snout'. In *Salmo* and *Salvelinus*, the lower jaw elongates more than the upper jaw and often develops a 'hook' at its tip which fits into a groove in the upper jaw to form a 'kype'.

"Among American species of *Salvelinus*, or charrs, the kype reaches its maximum development in large males of the stream-spawning or anadromous forms, *S. malma* and *S. fontinalis*, whereas it is hardly discernible or is absent in large males of the lake-spawning or nonanadromous forms, *S. alpinus* and *S. namaycush*. Recent evi-

dence of a kype developing in the anadromous or stream-spawning form of Arctic charr may indicate that the *Salvelinus alpinus* complex should be split into 2 species in America, a lake-spawning or nonanadromous Arctic lake charr, and a stream-spawning or anadromous Arctic brook charr."

1968a. Review of all Fishery Data and Information Collected from all waters of the Middle Fork Fishery Management Unit in Glacier National Park, Montana from 1916 through 1966. Review Report No. 6, Bureau of Sport Fisheries and Wildlife, Portland, Oregon, 77 typewritten pages.

Offers suggestions for fishery management program for Dolly Varden, and locates several isolated populations for special study.

1968b. Review of all Fishery Data Obtained from Waters of the McDonald Fishery Management Unit for the fifty-year period from 1916 through 1966. Review Report No. 7, Glacier National Park, West Glacier, Montana. 196 typewritten pages.

Describes the fishery, food and growth of Dolly Varden in Lake McDonald.

1968c. Review of all Fishery Data Obtained from Waters of the North Fork Fishery Management Unit from 1916 - 1966. Review Report No. 8, Glacier National Park. West Glacier, Montana. 112 typewritten pages.

Reviews the history and present status of the fishery for kokanee, Dolly Varden and cutthroat trout in several large lake drainages; offers suggestions for future management and studies; and locates half a dozen high lakes above impassable falls that contain relict populations of Dolly Varden for future research.

**Morton, W. M. and R. R. Miller**

1954. Systematic position of the lake trout, *Salvelinus namaycush*. Copeia, No. 2, pp. 116 - 124.

The primary purpose of publishing this paper was to question seriously both the validity of, and the necessity for, Theodore Gill's substitution of the generic name *Cristivomer* for *Salvelinus* in the case of this typically American form of lake charr. Photographs, charts and tables of selected meristic and morphometric data were presented to support this major thesis, and to demonstrate the probable taxonomic inter-relationship of the four most common species of charr native to America as (1) the lake charrs, *namaycush* and *alpinus*, and (2) the brook charrs, *fontinalis* and *malma*.

**Moser, J. F.**

1899. The salmon and salmon fisheries of Alaska. U.S. Fish Commission. Bulletin 18, 1898, pp. 1 - 178.

The bulletin mentions the Dolly Varden and cutthroat trout as serious predators on salmon eggs and that they are numerous in the Chilkat and Taku Rivers, Southeastern Alaska.

1902. Alaska salmon investigations in 1900 and 1901. Bulletin of the United States Fish Commission for 1901. 21:173-398.

*Salvelinus malma* found in L. Aleknagek. In Chignik the Dolly Varden are numerous and arrive a few days before the redfish and remain until late in the fall. In Olga Bay Dolly Varden as well as flounders, sculpins and cutthroat trout were found gorging themselves with humpback eggs. At Afognak the Dolly Varden appear with earliest salmon species and remain throughout the season. Horse Marine Lagoon had very large Dolly Varden trout present.

**Mullarkey, William G.**

1967. Observations on the limnology of Round Butte Reservoir, Oregon. Fish Commission of Oregon, Research Briefs, 13(1):60-86.

This report presents the numbers of Dolly Varden caught in the traps fished in Round Butte Reservoir, April, 1964 - May, 1965.



**Nagata, Thomas H.**

1967. Artificial spawning of anadromous Dolly Varden. Progressive Fish-culturist, 29(1):26.

The Alaska Department of Fish and Game, Sport Fish Division, located a stream system with large numbers of anadromous Dolly Varden available for artificial spawning. The Dolly Varden were captured with a bag seine, held in pens until ripe, and spawned by the dry method. Sixty-eight females were artificially spawned with approximately 220,000 eggs obtained. Problems encountered are discussed.

**Nakamura, Morizumi**

1963. Keys to the freshwater fishes of Japan fully illustrated in colors. (In Japanese). 258 pp., Hokuryukan Book Co., Tokyo.

**Narver, David W. and Michael L. Dahlberg**

1965. Estuarine Food of Dolly Varden at Chignik, Alaska. Transactions of the American Fisheries Society. 94(4):405-408.

Stomach contents of 282 *S. malma* are tabulated. Although juvenile red salmon and herring were most available, they were the least abundant in the Dolly Varden stomachs.

**Neave, Ferris**

1943. Scale pattern and scale counting methods in relation to certain trout and other Salmonids. Transactions of the Royal Society of Canada, Series III, Volume 37, Section V., pp. 79 - 91.

"It may be added that a few specimens of *Salvelinus fontinalis* and *S. malma spectabilis* also yielded counts [lateral line scale counts] well within the range shown by *Salmo clarkii* and *S. gairdneri*, namely 124 to 129."

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1964b. Creel census of the sport fishes in the Bristol Bay drainage. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1963-1964, Project F-5-R-5, Vol. 5, pp. 95 - 108.

The sport catch of Dolly Varden at military fishing camps and other wilderness camps in the Bristol Bay region is presented.

1965a. Inventory and cataloging of the sport fish and sport fish waters in the Bristol Bay and lower Kuskokwim drainages. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1964-1965, Project F-5-R-6, Vol. 6. pp. 231 - 247.

The sport catch of Dolly Varden in the Bristol Bay area is presented.

1965b. Creel census of the sport fishes in the Bristol Bay drainage, Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1964-1965, Project F-5-R-6, Vol. 6, pp. 263 - 272.

Presents information on the sport catch of Dolly Varden in the Bristol Bay drainage.

**Palmer, Irven F.**

1968. Strike creek dollies. Alaska Sportsman Magazine, April, p. 31.

An account of fishing for Dolly Varden near Shelikof Strait in Alaska.

**Parks, George A.**

1930. Trout Bounty Helps Indians. Pacific Fisheries, June, 28(7):27.

Dolly Varden Bounty in Alaska as a relief measure.

**Pavlovskii, E. N.**

1954. Key to parasites of freshwater fish of the U.S.S.R. Compiled by I. E. Bykhovskaya - Pavlovskaya et. al. Translated from Russian by A. Birron and Z. S. Cole for the Israel Program for Scientific Translations, Jerusalem. 919 pp.

Contains information on 30 species of parasites occurring in Dolly Varden.

**Peters, John C.**

1964. Age and growth studies and analysis of bottom samples in connection with pollution studies. Job Completion Report, Federal Aid in Fish Restoration, Project F-23-R-6, Montana Fish and Game Department, 76 pp.

"Over 5,000 scales were processed in the laboratory during the report period. Summary tables, listing the age and growth records from 1948 through 1961, are included in this report."

Presents the age composition of Dolly Varden sampled from lakes and streams in the Bitterroot River, Blackfoot River, Clark Fork Columbia River, Flathead River, and Kootenai River drainages. The ages of 3,324 Dolly Varden are included.

**Pochekaev, V. M.**

1949. Promyslovye ryby SSSR (Commercial Fishes of the U.S.S.R.). L. S. Berg, A. S. Bogdanov, N. I. Kozhina, and T. S. Rass, eds. Contains an atlas of colored drawings of fish, 10 pp., of text +230 separate tables of ill. in a folder; description of fishes (Text to the atlas of colored drawings of fish).—Moskva, Pishchepromizdat, 788 pp., ill., 10 separate tables of ill., bibliogr.: pp. 741-742. (Ministerstvo rybnoi promyshlennosti SSSR., VNIRO). Taken from Romanov (1966). Abst. No. 2027.

Describes *S. malma*.

**Popov, A. M.**

1933. Fishes of Avatcha Bay on the southern coast of Kamchatka. Copeia, No. 2, pp. 59 - 67.

"*Salvelinus alpinus malma* (Walbaum) is very common everywhere in the bay of Avatcha. In my collection there are specimens from Poganka River and from the sea near Petropavlovsk. Many young ones were taken in small lakes and brooks on July 30. Some very small specimens of the genus *Oncorhynchus*, from the small river falling into Chalaktirka Lake, differ from the very young of *Salvelinus alpinus malma* in their elevated bodies, and I think that they are *O. gorbuscha*."

1958. On measures of increasing the stock of far-eastern salmon. (O merakh po uvelicheniiu zapasov dal'nevostochnykh lososei). M., Rybnoe Khoziaistvo, No. 8, August, pp. 9-10. Sport Fishery Abstracts, 4(3), Abst. No. 2709, July 1959.

"Large salmon groups enter the rivers of the Okhotsk coast, and they are said to be inexhaustible.

"The Okhotsk River falls into the northwest part of the Okhotsk Sea, and has a hydrologic regime of mountain rivers. During the year the river has two floods: the spring flood and the summer-fall flood, which is longer and more abundant in water.

"Rivers of the Okhotsk coast do not need artificial food bases; they are well provided with natural food. Predation however, is an important problem.

"*Salvelinus malma* consume salmon roe and the young salmon. During spawning, *malma* also eats Okhotsk herring and its roe. After spawning, *malma* concentrate in deep places of the main river channel and winter there. Mature *malma* (over 250 grams) are estimated to number in the millions in the Okhotsk River alone. A dissected Okhotsk *malma* had 170 young keta and humpback salmon. *Malma* thus destroys millions of young salmon in one season.

"The most favorable period for *malma* trade is the end of April through June. As *malma* are caught at large distances from commercial centers, there is the problem of transportation and processing.

"It has been found expedient to create on the rivers of the Okhotsk area small processing bases with preservation and cooling systems. *Malma* is rich in fat, which tends to oxidize when kept long, so it should be frozen at once.

"Organizing and developing more bases of this type will bring large returns in fish economy. It will also permit the survival of keta and humpback salmon, and will insure the return of these fish to their native rivers in the Okhotsk area."

**Pravdin, I. F.**

1928. Ocherk zapadnok am chatskogo rybolovstva v svyazi s obshchimi voprosami dal'nevostochnoi rybopromyshlennosti (Outline of West Kamchatka Fishing in Connection with the General Problems of the Far Eastern Fish Industry). — Izvestiya TONS, 1(1):169-266. Vladivostok. Taken from Romanov (1966), Abst. No. 483.

Includes some general comments on the genus *Salvelinus* and on *S. malma*.

**Pritchard, Andrew L.**

1936. Stomach content analysis of fishes preying upon the young of Pacific salmon during the fry migration at McClinton Creek, Masset Inlet. British Columbia. Canadian Field-Naturalist 50(6):104-105.

Stomachs from 76 Dolly Varden were examined and the occurrence of pink salmon fry was noted. From the 76 stomachs examined, 6 were empty and 70 contained a total of 494 pink salmon fry for an average of 6.5 per stomach. Additional food items noted were 76 chum salmon fry; 46 coho salmon fry and fingerlings, 1 insect and 2 trout.

**Qadri, S. U.**

1964. Osteology and Morphology of the Genera *Cristivomer* and *Salvelinus* and their relationships with other Salmonids. Ph.D. Thesis Uni-

versity of Ottawa; 224 typewritten pages; 12 plates containing 100 photos of bone structures pp. 226-296.

Cranial and Caudal bones of *Salvelinus malma* are illustrated, described in detail and compared to other salmonid species exclusive of genus *Oncorhynchus*.

**Rahrer, Jerold Francis**

1963. Age and growth of four species of fish from Flathead Lake, Montana. Proceedings of the Montana Academy of Sciences, 23:144-156.

Age determination were made on 289 Dolly Varden ranging from 8.0 to 34.5 inches in total length. The youngest fish taken had three annuli. The annual growth increments for the first two years were 1.7 and 2.7 inches, respectively, while those for age classes III to VIII varied from 4.5 to 6.0 inches. The oldest Dolly Varden taken in Flathead Lake was eight years (total length, 34.5 inches; weight 20 pounds).

**Raleigh, Robert F.**

1956. Kodiak Island red salmon investigations, 1956 field season report, U.S. F. & W. S. Bureau of Commercial Fisheries, Alaska Region. 17 pp.

Age and growth data of Bare Lake Dolly Varden is presented. Scales were used to age the char. Stomachs from 69 Dolly Varden were examined and the results are presented. The samples were taken at several times during the season and the author suggests that the Dolly Varden were feeding upon the organisms most abundant at the time of collection.

"A modified Schnabel method of population estimate of resident Dolly Varden available to a ½" mesh seine yielded an estimate of 6,034 Dolly Varden."

**Rawson, D. S.**

1937. Report on the biological examination of the Kananaskis Lakes, Alberta. Fisheries Service, Department of Lands and Mines. Alberta 14 pp.

A few Dolly Varden were captured in Lower Kananaskis Lake, "they ranged from 7 inches 2 ounces to 14½ inches and 1 pound in weight. The larger specimens being 5 and 6 years old. The stomachs were found to contain fish remains (probably young suckers), stonefly and a few mayfly nymphs."

**Redding, Robert**

1967. Dolly Varden. Alaska Sportsman Magazine. April, pp. 34 - 35.

An account of fishing for Dolly Varden in the Agulowak River in Alaska.

**Redick, R. Russell**

1967a. Inventory and cataloging of the sport fish and sport fish waters in the Bristol Bay and Lower Kuskokwim drainages. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1966-1967, Project F-5-R-8, Vol. 8. pp. 189 - 203.

Recommends that investigations of the "golden" Dolly Varden, *Salvelinus malma*, stocks of Idavain Lake be initiated as time and manpower permits.

Large aggregations of Dolly Varden with a maximum size of about 545 mm are available in the lower part of the American River, but diminish abruptly about seven miles above the mouth.

1967b. Inventory and cataloging of the sport fish and sport fish waters in the Cook Inlet drainage. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1966-1967, Project F-5-R-8, Vol. 8, pp. 169 - 182.

Presents information on gill net sampling of Dolly Varden from two Matanuska Valley lakes and winter creel census information from one Matanuska Valley lake.



1967c. Creel census of the sport fishes of the Bristol Bay drainages. Alaska Department of Fish and Game. Federal Aid in Fish Restoration; Annual Report of Progress, 1966-1967, Project F-5-R-8, Vol. 8, pp. 205 - 215.

"The percentage of Dolly Varden and Grayling in the catch continues to decline. [Naknek River] The reduced catch of these species is probably related to reduced fishing effort prior to the June 8 rainbow opening. Sport Fish personnel saw, or captured by pole and line, many grayling and numerous Dolly Varden during May and early June. These species decreased sharply in availability by mid-June. Most of the reported military catch occurred during the spring."

"A sizable Dolly Varden fishery exists in lower King Salmon Creek during May. Seven creel checks showed 48 anglers had fished 59 hours for 33 Dolly Varden and 1 grayling for an overall catch rate of 0.56 fish per hour."

"The success of this fishery depends upon weather conditions as the stream frequently becomes muddy."

**Red'ko, B. A.**

1927. Aleuty Komandorskikh ostrovov (Aleuts of the Commander Islands). — In the book: "Proizvoditel'nye sily Dal'nego Vostoka. No. 5. Chelovek", pp. 69-112. Khabarovsk-Vladivostok, "Knizhnoe delo". Taken from Romanov (1966), Abst. No. 395.

"Fisheries off the Bering and Mednyi Islands (pp. 102-106); commercial fishes, methods of fishing and storage. Fishing of salmonids on Bering Island in 1923. Hunting for sea mammals."

Includes information on *S. malma*.

**Reed, Roger J.**

1964. Effects of DDT on the ecology of salmon streams in southeastern Alaska. Bureau of Commercial Fisheries, Biological Laboratory. Auke Bay, Alaska; Manuscript Report Series, 64-3; 34 pp.

Contains a table of the frequency of occurrence and the total volume of food items in stomachs of 272 Dolly Varden sampled from Old Tom Creek. Prince of Wales Island, Southeastern Alaska 1961 - 1962.

1967a. Observations of fishes associated with spawning salmon. Transactions of the American Fisheries Society 96(1):62-67.

Underwater observations were made on Dolly Varden, *Salvelinus malma*. feeding on salmon eggs in Old Tom Creek, Southeastern Alaska. Reed concluded that Dolly Varden may gorge themselves on drifting eggs but contribute very little to direct egg mortality and that the species is not the major salmon egg predator in Old Tom Creek. Information is presented on the stomach contents of 322 Dolly Varden and the numbers and tagging of Dolly Varden in Old Tom Creek.

1967b. Age and growth of Prince of Wales, Alaska, Dolly Varden, *Salvelinus malma* (Walbaum), and rainbow trout, *Salmo gairdneri* Richardson. Transactions of the American Fisheries Society 96(2):223-224.

Age classes I+ to V+ were determined for Dolly Varden and the age and growth determinations were compared with the results of other studies on the age and growth of Dolly Varden in Southeastern Alaska.

Reed also mentions that Dolly Varden were infected with four parasites: black spot, *Neascus* sp.; copepod, *Salmincola* sp.; nematode, *Eustrongylides* sp.; and the round worm, *Philonema* sp.

**Regan, C. Tate**

1914. Systematic arrangement of the fishes of the family Salmonidae. Annals and Magazine of Natural History, Series 8, 13(76):405-408.

Some information on the distribution of Dolly Varden is given.

**Revet, L.**

1962. A preliminary study of the migration and growth of the Dolly Varden char in Kitoi Bay, Alaska. Alaska Department of Fish and Game Informational Leaflet No. 17, 6 pp.

"In the spring of 1961, 548 Dolly Vardens left the lake and 277 returned in the fall. Of the 277 inmigrants returning to Little Kitoi Lake, only 115 had migrated out in the spring. In 1962, 519 Dolly Varden left Little Kitoi Lake in the spring and 559 returned in the fall. Of the 559 inmigrants returning to Little Kitoi Lake, 223 had migrated out in the spring. A comparison of lengths and weights of the returning tagged out-migrants showed that these fish which had been at sea less than two months had doubled their weight.

"Sightings of tagged Dolly Vardens were made as far as 2 miles from Little Kitoi Lake. Also rod and reel sampling showed that clipped and unclipped dollies intermingled at sea; however, lack of time and equipment prevented more adequate sampling to determine the extent of mixing of the populations."

**Ricker, William E.**

1933. Destruction of sockeye salmon by predatory fishes. Biological Board of Canada. Progress Reports of Pacific Biological Station, Nanaimo, British Columbia and Fisheries Experimental Station, Prince Rupert, British Columbia No. 18. pp. 3-14.

"Dolly Varden (*Salvelinus malma*). Individually these are more destructive to sockeye than are any other fish in the lake. The specimens taken in the nets ranged from eleven to twenty-seven inches in length, and all fed largely upon young salmon. The greatest numbers were found in May and in mid-July, when stomachs contained an average of 17 sockeye each, and individual fish had as many as 90. At two seasons the Dolly Varden turned largely to other foods; in June, when they ate large numbers of the small sculpin, *Cottus aleuticus*, and during January and February when they gorged upon the decaying carcasses of adult salmon."

1941. The consumption of young sockeye salmon by predaceous fish. Journal of the Fisheries Research Board of Canada, 5(3):293-313.

In Cultus Lake, British Columbia, Dolly Varden less than 300 mm long have a uniform diet of fingerling sockeye and of other fish, largely *Cottus aleuticus*. Char more than 300 mm long, while maintaining these as staples, add more variety in the way of shiners, sticklebacks, squawfish and prickly sculpins. The number found in individual stomachs ranges up to 93, with 10 or 12 per stomach examined a common average (301 Dolly Varden stomachs examined).

1960. A population of dwarf coast-range sculpins (*Cottus aleuticus*). Journal of the Fisheries Research Board of Canada. 17(6):929-932.

"*Cottus aleuticus* in Cultus Lake, British Columbia, inhabits deep water, grows slowly to a maximum length of about 50 mm in 3 or 4 years, and spawns in the lake throughout the summer. It was taken abundantly from the stomachs of Dolly Varden char; other fish eat it only rarely. Its summer food is plankton and microbenthos."

**Robbins, Otis, Jr.**

1966. Flathead Lake (Montana) fishery investigations, 1961-64. Bureau of Sport Fisheries and Wildlife. Technical Paper No. 4, 26 pp.

"Creel census investigations on Flathead Lake in Montana were conducted from 1961 to 1964 to determine utilization and harvest, activities of fishermen, and characteristics of the fish resources. Data on fishermen's activities were collected by personal interview and postal questionnaire surveys devised particularly for use on this large lake covering 197 square miles. A total of 3,518 personal interviews were obtained during the period October 2, 1961, to November 30, 1963, and 40,080 postal questionnaires were sent to license holders in five separate surveys. Information is presented on launching sites, starting times, stopping times, residence of fishermen, catch success, fishing pressure distribution, annual utilization, and numbers, lengths, and weights of fishes."

Presents creel census information on Dolly Varden caught in Flathead Lake.

**Roguski, Eugene**

1967. Inventory and cataloging of the sport fish and sport fish waters in the interior of Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1966-1967, Project F-5-R-8, Vol. 8, pp. 231-246.

Roguski presents a chart showing number of Dolly Varden caught by anglers in the Eielson Unalakleet Fishing Camp in 1964, 1965 and 1966.

**Romanov, N. S.**

1966. Annotated Bibliography on Far Eastern Aquatic Fauna, Flora, and Fisheries (1923-1956) 391 pp. Translated from Russian and Published for the U.S. Department of the Interior and the National Science Foundation, Washington, D.C. by the Israel Program for Scientific Translations.

Contains a comprehensive bibliography of 2,931 works on fish and fisheries (Section 1 pp. 3-258); 433 on mammals; 209 on invertebrates and 117 on algae. The annotations are very brief — and usually do not mention charrs, unless they are the subject of the paper. However, the author and subject index and the explanation and the translation of abbreviations for Russian journals in the appendix are very useful.

**Roos, John F.**

1959. Feeding habits of the Dolly Varden (*Salvelinus malma* Walbaum), at Chignik, Alaska. Transactions of the American Fisheries Society, 88(4):253-260.

"Stomach contents of 5,050 Dolly Varden were examined during the summers of 1955 and 1956 to determine the extent of predation by this species upon young sockeye (red) salmon (*Oncorhynchus nerka*). Of 5,050 stomachs examined, 2,667 (52.8 percent) were empty. Of those containing food, 73.2 percent contained insects, and 9.0 percent sockeye salmon. In all, the 214 Dolly Varden which had been feeding on young sockeye had consumed 649 salmon for an average of 0.1 sockeye for all Dolly Varden examined.

"Predation was greatest in rapid water immediately below the outlet of Chignik Lake and here 31.1 percent of the Dolly Varden stomachs contained sockeye. Greatest predation occurs where swift current and natural obstacles restricted movement of young salmon. There was a direct relationship between size of trout and proportion with food; small fish more often had food in their stomachs. It appears that Dolly Varden feed more actively during their summer stay in salt water than during their winter residence in the lakes. It seems unlikely that the Dolly Varden is a serious predator upon the salmon in the Chignik Lake drainage."

**Rostlund, Erhard**

1951. Three early historical reports of North American freshwater fishes. Copeia, No. 4, pp. 295-296.

Rostlund relates an early account of Dolly Varden observed in the Bear River, a tributary to the Great Salt Lake.

1952. Freshwater Fish and Fishing in Native North America. University of California Publications in Geography. Volume IX. 313 pp.

This contains a distributional map for Dolly Varden in North America. Notes on the range and distribution of Dolly Varden are presented.

**Rounsefell, G. A.**

1957. Fecundity of North American Salmonidae. U.S. Fish and Wildlife Service, Fishery Bulletin, 57(122):451-468.

This discusses the work done by Brunson (1952).

1958a. Factors causing decline in sockeye salmon of Karluk River, Alaska. U.S. Fish and Wildlife Service, Fishery Bulletin, 58 (130):83-169.

The author discusses several papers dealing with the Dolly Varden as a predator on salmon young.

1958b. Anadromy in North American Salmonidae, U.S. Fish and Wildlife Service, Fishery Bulletin, 58(131):171-185.

"Although there is a considerable range of variation in anadromy between species of the same genus, each of the four genera of North American Salmonidae occupies a different position in degree of anadromy exhibited. Arranged in descending order of degree of anadromy, the genera are *Oncorhynchus, Salmo, Salvelinus,* and *Cristivomer*."

The Dolly Varden are discussed with regard to the extent of their migrations in the sea; duration of stay in the sea; state of maturity attained at sea; spawning habits and habitat: mortality after spawning and the occurrence of freshwater forms.

1962. Relationships among North American Salmonidae. U.S. Fish and Wildlife Service, Fishery Bulletin. 62(209):235-270.

"The strengths of the relationships among species and genera of North American Salmonidae are assessed from published data on hybridization, coloration and other attributes. The genus *Salmo* shows the greatest intrageneric variation. Phylogenetically, *Salmo gairdneri* is as close to the species of *Oncorhynchus* as to *Salmo salar;* and *Salmo trutta,* at the other extreme, is about midway between *S. salar* and the species of *Salvelinus.* The genus *Salvelinus* is a closely knit group. Of its species, *Salvelinus marstoni* shows the closest affiliation with *Salmo.*

"Published data are scanty for several species and the methods of taking and recording data vary so widely that comparison of data taken by different investigators is hazardous."

For Dolly Varden, data are presented on coloration, anadromy and meristic characters.

**Rozov, V. E.**

1938. O faune i flore Tuguro-Chumikanskogoraiona (Fauna and Flora of the Tugur-Chumikan Area).— Vestnik DVFAN SSSR, No. 32-(5):127-138. Taken from Romanov (1966), Abst. No. 1491.

"Ichthyofauna of the region. Distribution of fishes, short data on their biology, according to observations from 1935 - 1936."

Includes information on *S. malma.*

**Rutter, Cloudsley**

1907. The fishes of the Sacramento-San Joaquin Basin, with a study of their distribution and variation. Bulletin of the U.S. Bureau of Fisheries, 27:105-152.

This contains a short note on the Dolly Varden stating that it was "reported by Bean, 1880, and by various sportsmen from the McCloud River; not otherwise known from the basin."

**Ryckman, M. L.**

1925. The Oregon Sportsman, 1(5):11-12.

"They (*S. malma*) are considered very detrimental — not only to the salmon industry — but to game fish propagation and undoubtedly our streams would produce many more game fish were it possible to entirely exterminate the Dolly Vardens."

**Saario, Doris J. and Brina Kessel**

1966. Human Ecology Investigations at Kivalina. In "Environment of the Cape Thompson Region, Alaska." Edited by Wilimovsky, Norman J. and John N. Wolfe. Published by the United States Atomic Energy Commission. Chapter 35, pp. 969 - 1039.

"Fish play a vital part in the subsistence economy of the Kivalina people. The major portion of the fish catch consists of Dolly Varden (*Salvelinus malma*), which is called Ahkalukpik, or the Kivalina trout. It is renowned in the region for its large size and good eating.

"The Dolly Varden leave the streams for the ocean in June, and some fishing occurs at that time. These fish are sometimes obtained by seining but more frequently by gill nets or rod and reel. At times during the month of June, it is possible to obtain them with almost every cast of the line. The fish obtained at this time are eaten fresh or hung to dry and later stored in seal oil for the winter. Approximately 10,000 pounds were obtained in June 1960.

"The major fishing activities of the year occur in the fall when the fish return to the streams. Dolly Varden begin to arrive at the middle of August and are reported to return in distinct waves. The first wave consists of medium-sized and small fish; the second, of small fish; the third, of fairly large fish; and the last of the very largest fish accompanied by small fish and found in association with whitefish (*Coregonus* sp.), or Kahlrak. The last wave arrives toward the end of September. Early arrivals are caught with rod and reel and with gill nets set near the Aulik Channel. Fish obtained in this manner probably do not amount to more than 1,000 pounds.

"Dolly Varden is the major type of fish sought in the winter fishing and is caught by far the most frequently.

"Fish are used primarily as dog food although they are a staple of the human diet. Most of the Dolly Varden obtained in September are used for dog food because it is too early to freeze them."

**Savvaitova, K. A.**

1960. O pitanii dal'nevostochnyk h gol'tsov. (On the food of far-eastern chars). Rybnoe Khoziai'stvo, 38(2):9-11. Translated by R. E. Foerster, Fisheries Research Board of Canada Biological Station, Nanaimo, B.C., 1962. Translation series No. 423.

"It is impossible to consider char solely as predators of fish, in all cases deserving of elimination. Obviously in some instances one of the forms of the char may exert a harmful influence on populations of *Oncorhynchus* by destroying their young. Nevertheless, it is impossible to assume that *all* forms are harmful in all waters. On the contrary, in many cases char are beneficial in that they destroy small useless plankton-eating fishes, as was shown earlier by F. V. Krogius and E. M. Krokhin. In reducing the abundance of char by intensive fishing for them, we create conditions favourable for the development of food competitors of those salmon whose young remain in fresh water for a prolonged period. As a result, their feeding conditions are made worse. Feeding of char on benthic organisms (molluscs, larval insects, crustacea) cannot, especially in Kamchatka, play a detrimental role since these organisms are not consumed by young salmon. Finally, the feeding of char on salmon eggs cannot cause damage to the runs of salmon since most probably none of the eggs which are washed out of the redds can produce viable fry.

"It seems to me that there should be a fundamental review of the question of damage caused by *S. malma* and *S. leucomaenes.* In some lakes it is desirable to preserve them as a valuable fish, which are available to a fishery regardless of season."

Stomachs of 529 Dolly Varden were examined.

1961a. Comparative morphology (or systematics) of charrs *Salvelinus.* (Salmonidae) from the basin of the last Siberian Sea. Hauchnye Doklady Vysshei Shkoly, Biol. Nauk 2:37-41. 7 pp.

Presents several morphometric and meristic characters of charrs from the Gulf of Chaynski, concludes that the present data does not present any basis for separating *Salvelinus alpinus* and *S. malma*.

1961b. The taxonomic status of Kamchatka chars of the genus *Salvelinus*. (O sistematicheskom polozhenii Kamchatskikh gol'tsov roda *Salvelinus*.) Zool. Zhur. 40-(11):1696-1703; Referat. Zhur., Biol. 1962, No. 817; Biological Abstracts, 40(1), Abst. No. 4223. 1962.

"Two spp. of chars live in Kamchatka waters: *S. leucomaenis* and *S. alpinus*. *S. malma* (Walb.), described for the Pacific Ocean province of the Holarctic region, is a synonym for *S. alpinus*. Evidence of this synonymy is provided by data from a morphometric analysis and by the specific biological charteristics. It is likely that the previously described spp. of chars of Siberia and the Far East are synonyms of *S. alpinus*."

1961c. The nutrition of Far-Eastern chars. (O pitanii dal'nevostochnykh gol'tsov.) Rybnoe Khoz. 1. 9-11; Referat. Zhur., Biol., 1961, No. 18D310; Biological Abstracts, 38(1), Abst. No. 723. 1962.

"The results are presented of a study of the nutrition of various forms Dolly Varden (*Salvelinus malma*) from Kamchatka bodies of water and of the kundzha (*Salvelinus leucomaenis*) of the Vavai lakes of Sakhalin. The migratory form of *malma* and the dwarf males feed principally on water and aerial insects. The nutrition of the lake-river form is more varied. Small *malma* in Lake Dal'nee feed on the water larvae of insects, large *malma* on mollusks and three-spined sticklebacks (*Gasterosteus aculeatus*) and their eggs. During the spawning period of sockeye salmon, its eggs appear in the stomachs of small char. It is assumed that these eggs perish on being washed out of the nest. The non-migratory lake *malma* is a typical predator with a broad food spectrum. In the diet of the kundzha, the chief item is small fish, while salmon eggs are also encountered. It is believed that char are useful in destroying small waste fish; in some cases, one of the forms of char may have a harmful effect upon the population of salmon of the genus *Oncorhynchus*."

**Savvaitova, K. A. and Ia. S. Reshetnikov**

1961. Pitanie razlichnykh biologicheskikh form gol'tsa — *Salvelinus malma* (Walb.) v nekotorykh vodoemakh Kamchatki. (The food of different biological forms of the Dolly Varden char, *Salvelinus malma* (Walb.) in certain Kamchatka waters). Translated by R. E. Foerster, Fisheries Research Board of Canada Biological Station, Nanaimo, B.C., 1962. Translation Series No. 373. Voprosy Ikhtiologii, 1(1):127-135.

"In all, 529 stomach contents were examined. Of these, 91 contained no food.

"Anadromous, lake-stream and lake forms of char differ in the character of their food. The anadromous char feed mainly on terrestrial insects and aquatic larval forms of insects, the lake-stream — principally on molluscs, the lake-resident — are predaceous.

"For each biological form the character of the food varies according to the size of the fish, the season and the actual conditions prevailing in the area inhabited.

"The results obtained confirm the conclusions reached earlier by F. V. Krogius and E. M. Krokhin (1948, 1956) that char are not always harmful to other fish. In the regions examined, the char consume smelt and sticklebacks, which are food competitors of young sockeye, and thus they are more beneficial than harmful. Since they feed on the eggs of salmon the char may be considered to play a 'sanitary' role on the spawning grounds, destroying that which must inevitably die, i.e., those eggs which are washed away during spawning and during the digging up of the redds by later-arriving salmon.

"There is a wide variability in the food of the various forms of char. Each has a specific type of food, natural for each form and permitting it to occupy a different food niche. On the whole, this serves to assure the full utilization of the diverse food resources of the waters."



**Schmidt, P. Yu**

1950. Ryby Okhotskogo morya (Fishes of the Sea of Okhotsk).—Moskva-Leningrad, Izd. AN SSSR, 370 pp., ill., maps: 23 sheets of ill., bibliogr.: pp. 337-351. (An SSSR. Trudy Tikhookeanskogo komiteta, Vol. 6). Taken from Romanov (1966), Abst. No. 2142.

"Composition and distribution of ichthyofauna of the Sea of Okhotsk. its origin, and comparison with the Arctic ichthyofauna." Refers to *S. malma, S. malma curilus* and *S. malma krasheninnikovi*.

**Schrenkeisen, Ray**

1938. Field Book of Fresh-water Fishes of North America. North of Mexico. G. P. Putman's Sons, N.Y. pp. 34 - 58.

Contains excellent descriptions of *S. malma*.

**Schultz, Leonard P.**

1941. Fishes of Glacier National Park. Montana. USDI National Park Service Conservation Bulletin No. 22. 42 pp.

*S. malma spectabilis* in Glacier Park.

1963. Keys to the fishes of Washington. Oregon, and closely adjoining regions. University of Washington Publications in Biology, 2(4):103-228. (First published in 1936).

This work contains a key to the genus *Salvelinus* and a brief description of Dolly Varden.

**Schultz, Leonard P. and Allan C. DeLacy**

1935. Fishes of the American Northwest. Part I. Catalogue of the fishes of Washington and Oregon with distributional records. Journal of the Pan-Pacific Research Institution, 10(4). In Mid-Pacific Magazine, October-December, pp. 365 - 380.

Contains distribution records of Dolly Varden from Washington and Oregon.

1936a. Fishes of the American Northwest. Addenda to Part I. Mid-Pacific Magazine, July-September, pp. 211 - 213.

Contains additional distribution records of Dolly Varden to that published by Schultz and DeLacy (1935).

1936b. Fishes of the American Northwest. Part III. Bibliography. Mid-Pacific Magazine, July-September, pp. 215 - 223.

Includes several early publications concerning the distribution records of Dolly Varden.

**Schultz, L. P. and H. A. Hanson**

1935. Salmonoid Game Fishes in the National Forests of Northwestern United States. Seattle. 26 pp. (Mimeographed).

Contains helpful taxonomic notes on *Salvelinus malma*.

**Schwartz, Benjamin**

1937. A letter received by the U.S. Forest Service, Juneau, Alaska, concerning the parasites of Dolly Varden from Sitkoh Bay, Alaska.

The following information was included in this letter: "Nematodes: *Philonema* sp.? n. sp. and Anisakinae larvae from 7 specimens of Dolly Varden. Acanthocephala: *Neoechinorynchus* sp. from 1 Dolly Varden. Tapeworms: Probably *Abothrium* sp. from pyloric caeca of 7 specimens of Dolly Varden. Crustacea: Gill lice were

present on 2 Dolly Varden. Trematoda: Many small distomes from small intestine of 4 Dolly Varden; immature distomes from gall bladder of 1 Dolly Varden. Monogenetic trematoda: *Tetraonchus alaskensis*, a new species described by Price (1937) from the gills of 1 Dolly Varden."

**Scofield, N. B.**

1899. List of Fishes obtained in the waters of Arctic Alaska. U.S. Treasury Dept. Commission on Fur-Seal Investigations, The fur-seals and fur-seal islands of the North Pacific Ocean. pt. 3. pp. 493 - 509.

"*Salvelinus malma*. Specimens were obtained at Port Clarence, Point Hope, and Herschel Island. The natives of Herschel Island catch this fish through holes in the ice at all times during the winter."

**Semko, R. S.**

1948. O biotsenoticheskikh vzaimootnosheniyakh tikhookeanskikh losoei i gol'tsov v nerestovo-vyrostnykh uchastkakh r. Bol'shoi (Zapadnoe poberezh'e Kamchatki) (Biocoenotic Relationships of Pacific Salmon and Char on the Spawning Grounds of the Bol'shaya River [Western Coast of Kamchatka]). Zoologicheskii Zhurnal, 27(1):27-38, 7 bibliogr. ref. Taken from Romanov (1966), Abst. No. 1921.

"Interspecific and interage relationships between the young of salmon in the Karymaiskii spring in the spring-summer period. Evaluation of the interseasonal variability of the role of predators; their daily food; data on the eating out of the young of salmon by predators. The author concludes that the main predators are young and adult char [*S. malma*] and coho of various ages."

1954a. Zapasy zapadnokamchatskikh losoei i ikh promyslovoe ispol' zovanie (Izlozhenie kandidatskoi dissertatsii) (Stocks of West-Kamchatka Salmon and Their Commercial Utilization [Summary of Candidate Thesis]). — Izvestiya TINRO, Vol. 41:3-109, bibliogr.: pp. 106-109. Taken from Romanov (1966), Abst. No. 2624.

According to Romanov (1966) this article contains information on *S. malma*. This information is presumed to concern the food habits of the anadromous Dolly Varden in fresh water.

1954b. Metodka opredeleniya vyedaniya khishchnikami malkov tikhookeanskikh losesei na rannikh stadiyakh razvitiya. (A method for determining the consumption by predators on the young of Pacific salmon during the early stages of development.) Translated by R. E. Foerster, Fisheries Research Board of Canada Biological Station, Nanaimo, B.C.. 1959. Trudy soveshchaniya po metodike izucheniya kormovoi basy i pitaniya ryb. Vol. 6, pp. 124 - 234.

Information is presented on their food and feeding habits, and purpose of migration, of the Dolly Varden.

**Sexsmith, Jeremy C.**

1962. Inventory and cataloging of the sport fish and sport fish waters of Southwestern Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1961-1962, Project F-5-R-3, Vol. 3, pp. 31 - 40.

Includes information on sport catch. length and presence of Dolly Varden from lakes and streams of Kodiak Island.

1963. Inventory and cataloging of the sport fish and sport fish waters of Southwest Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1962-1963, Project F-5-R-4, Vol. 4, pp. 129 - 143.



An estimate of the percent of Dolly Varden found among the fish populations of several lakes and streams of Kodiak Island.

**Seymour, Allyn H. and Roy E. Nakatani**

1967. Long shot bioenvironmental safety program. University of Washington Laboratory of Radiation Biology Report No. RL-1385-1; 47 pp., Seattle.

"To relate pressure measurements with effects upon aquatic organisms we placed the live-boxes in the proximity of the pressure-wave measuring instruments installed by WES in Cyril Cove, Kirilof Bay, Constantine Harbor and at the 2,500-foot pond. Other live-boxes were located at the 4,000-pond and at the Yacht Club pond. In addition, cartridges containing freshly fertilized Dolly Varden trout eggs were placed in Cyril Creek and the Yacht Club pond. (For station locations see Fig. 1.) The summary of live-box and Dolly Varden trout egg experiments given in Table 3 indicates that there was no apparent loss from seismic shock."

**Shaw, J. N.**

1947. Some parasites of Oregon Wild Life. Agricultural Experimental Station Technical Bulletin 11: 16 pp. Oregon State University, Corvallis, Oregon.

Article mentions the known parasites of *S. malma*.

**Shebley, W. H.**

1931. Trout lives 19 years. California Fish and Game, 17(4):441.

An account of a Dolly Varden raised for 19 years at the Shasta trout hatchery. The fish produced between 20,000 and 30,000 eggs during its lifetime.

**Skinner, Edna and Ann**

1968. Hello Dolly! Western Outdoors Magazine. October. pp. 40-42; 58.

This article presents information on fishing for Dolly Varden in Flathead Lake, Montana.

**Smoker, W. A.**

1956. Kitoi Bay Research Station. Alaska Department of Fish and Game. Annual Report for 1956, pp. 35-39.

Concerning Dolly Varden, limited information is presented on food and feeding habits, counts of migrant adults and marking and recapture data.

**Snyder, John O.**

1940. The Trouts of California. California Fish and Game, 26(2): 136-137.

Contains a brief description of *S. spectabilis* and reference to its predatory habits.

**Soldatov, V. K.**

1928. Ryby i rybnyi promysel (Kurs chastnoi ikhtiologii) (Fishes and Fisheries [A Course in Special Ichthyology]). — Moskva, GIZ XV +320 pp. illust., bibliogr. pp. 318 - 320. Taken from Romanov (1966), Abst. No. 494.

"Biology, fisheries and systematics of Far Eastern Fishes." Includes *S. alpinus malma*.

1938. Promyslovaya ikhtiologiya, ch. II. Ryby promyslovykh raionov SSSR. Dopushcheno NKPishchepromom SSSR v kachestve uchebnogo posobiya dlya vuzov (Commercial Ichthyology. Part II. Fishes from the Fishing Areas of the U.S.S.R. Published by NKPishcheprom SSSR as a Textbook for Colleges). — Moskva - Leningrad, Pishchepromizdat, 303 pp., figs., 211 bibliogr. ref. Taken from Romanov (1966), Abst. No. 1492.

Includes information on *S. malma* and *S. malma kraschenninnikovi*.

**Soldatov, V. K. and G. U. Lindberg**

1930. Obzor ryb dal'nevostochnykh

morei (Survey of Fish from Far Eastern Seas). — Vladivostok, XLVII +576 pp., ill. (Izvestiya TIRKh, Vol. 5). Taken from Romanov (1966), Abst. No. 750.

"A general resume and critical survey of all the material collected, up to 1930, about the marine ichthyofauna of the Far East (262 genera and 460 species)."

Includes notes on *S. alpinus malma.*

**Sparrow, R.A.H., P. A. Larkin and R. A. Rutherglen**

1964. Successful introduction of *Mysis relicta* Loven into Kootenay Lake, British Columbia. Journal of the Fisheries Research Board of Canada. 21(5):1325-1327.

Dolly Varden stomach samples from the west and north arms of Kootenay Lake contained *Mysis relicta.*

**Sprague, A. J.**

1921. The Alaska Salmon and their Practical Propagation. 24 pp.

Mentions "the larger Dolly Varden or salmon trout of the short coast streams go to salt water for the winter, but where large lakes are found on the larger streams, they remain in the deep water lakes, for that period."

1938. Observations on the annual migrating habits of the Dolly Varden trout species. Unpublished report of the U.S. Forest Service, Juneau, Alaska.

Some information is given on the timing and numbers of Dolly Varden migrating to sea from Eva Lake. Baranof Island, Southeastern Alaska.

**Stefanich, Frank A.**

1958. Survey of cutthroat trout fishery in the Flathead River and tributaries above Flathead Lake. Job Completion Report, Federal Aid in Fish Restoration, Project F-7-R-7, Montana Fish and Game Department, 3 pp.

"Main emphasis was directed toward a study of the Middle Fork of the Flathead River. This was due to the anticipated construction of Spruce Park Dam. A two-way trap was constructed on the river just above the mouth of Bear Creek. A total of 209 Dolly Varden trout were tagged. They were captured by crews at the trap through sampling streams with the electric shocker method and by fishing while floating the river. Nine fish were recovered, of which four were caught in Flathead Lake. These four fish traveled from 96 to 117 miles. A total of 38 cutthroat trout were tagged and two were recovered within 600 yards of place of tagging.

"Population studies indicated that the river above the mouth of Bear Creek contained only native species: Dolly Varden trout, cutthroat trout and mountain whitefish."

1962a. Population studies of king salmon in the upper Cook Inlet drainage. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1961-1962, Project F-5-R-3, Vol. 3, pp. 87 - 99.

The sport catch of Dolly Varden from some streams in the Cook Inlet area is presented.

1962b. Creel census of the sport fishes in the Bristol Bay drainages, Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1961-1962, Project F-5-R-3, Vol. 3, pp. 207 - 220.

Information on the sport catch of Dolly Varden taken at military camps in Bristol Bay is presented.

**Suckley, George**

1874. On the North American species of salmon and trout. Appendix B, part 3:91-160. In Report of the Commissioner for 1872 and 1873, United States Commission Fish and Fisheries. 808 pp.

Contains original descriptions of *S. Parkei, bairdii* and *campbelli* — all synonyms of *S. malma* in North America.



**Suvorov, E. K.**

1948. Promyslovye vodoemy SSSR. Vvedenie v chastnuyu ikhtiologiyu (Fishing Waters of the U.S.S.R. Introduction to Special Ichthyology).—Leningrad, Izd. LGU, 238 pp., figs., maps, bibliogr. at the end of chpts. Taken from Romanov (1966), Abst. No. 1925.

"Seas of the Far East (pp. 92-236). Geological history and physical survey. Ichthyofauna and its origin. Fishery technique."

Includes *S. malma* and *S. malma curilus.*

**Tanaka, Shigeho**

1909. Notes on Fresh-water Fishes from the Province of Shimano, Japan. Annot. Zool. Japanenses, Vol. VII. pp. 125 - 138.

"*S. malma* — local name Iwana, 12 spec. up to 25 cm long, note on *S. kundscha.*"

1931. On the distribution of fishes in Japanese waters. Imperial University of Tokyo, Journal Faculty of Science Section IV, Zoology 3(1):1-90 3 pl.

*Salvelinus malma* descends to sea in northern Japan and is entirely landlocked in the upper course of the stream in southern Japan. p. 61: "*Salvelinus malma* (Walbaum) has Takatsu River in Prov. Iwani on Japan Sea side and Iwakuni River on the Inland Sea side as its western limit; and Provinces Yamato and Kii as its southern limit, not occurring in Shikoku nor in Kiushiu."

"*S. malma* and *S. pluvius* (Higendorf) appear to be merely local variations of *malma.*"

**Taranets, A. Ya**

1937a. Kratkii opredelitel' ryb sovetskogo Dal'nego Vostoka i prilezhashchikh vod (Short Key to Fishes of the Soviet Far East and Adjacent Waters).—Vladivostok, 200 pp., figs., Bibliogr.: 7-9 and 171. (Izvestiya TINRO, Vol. 11). Taken from Romanov (1966), Abst. No. 1434.

The key includes fishes living not only in Soviet waters of the Far East, but also in the Bering Sea, the Sea of Okhotsk, the northern half of the Sea of Japan, off the Aleutian and Kuril Islands, and off the Pacific coast of Hokkaido Island."

Includes information on *S. malma.*

1937b. Materialy k poznaniyu ikhtiofauny Sovetskogo Sakhalina (Data on the Ichthyofauna of Soviet Sakhalin). — Izvestiya TINRO, Vol. 12:5-50, 10 bibliogr. ref. Taken from Romanov (1966), Abst. No. 1435.

"Lists of fishes of the Tym' and Poronai River Basins, the Srednevostochnyi and Rybnovskii areas, and the rivers of the southwestern region. Data on the size, growth rate, and feeding of several fishes; their local names."

Includes *S. malma curilus* and *S. malma krascheninnikovi.*

1938a. K zoogeografii Amurskoi perekhodnoi oblasti na osnove izucheniya presnovodnoi ikhtiofauny (Zoogeography of the Amur Transitory Region, Based on a Study of the Freshwater Ichthyofauna). — Vestnik DVFAN SSSR, No. 32(5):99-115, 24 bibliogr. ref. Taken from Romanov (1966), Abst. No. 1495.

"Origin of the present ichthyofauna of the Amur transitory region, and some rules of its distribution." Includes *S. malma; S. malma curilus; S. malma krascheninnikovi;* and *S. malma malma.*

1938b. Morskie i presnovodnye promyslovye bogatstva Dal'ne—Vostochnogo kraya (Marine and Freshwater Fishery Resources of the Far Eastern Territory).—Vestnik

"At the Lower Lake weir there were peak movements, both upstream and downstream during the spring and fall. Fish in the upstream trap ranged from 71 to 188 mm. (2.8 to 7.4 inches). They were well distributed throughout the size range with no definite pattern by season. In the downstream trap, fish ranged in size from 74 to 272 mm. (2.9 to 10.7 inches). Most of the fish were well distributed in the size range 74 to 163 mm. (2.9 to 6.4 inches), with relatively few larger ones. Four sexually mature fish were recorded in the downstream trap in September."

Table 9 in this report shows numbers of Dolly Varden trapped at the Upper and Lower Fire Lake weirs during 1966, by weekly periods.

**Wallis, O. L.**

1948. Trout Studies and a Stream Survey of Crater Lake National Park, Oregon. M.S. Thesis June 1948 Oregon State University, Corvallis Oregon., 125 pp.

In 1947 fourteen small Dolly Vardens 5 to 9 inches long were collected from below the 150-foot cascade falls in Sun Creek, a tributary of Wood River in the Klamath River drainage. A detailed break-down of the food (100% insects) found in the stomachs of eleven of these little fish is presented in table 16. Condition factor averaged 1.4, and one 6-inch female had 74 eggs and two 7.5 inch females averaged 337 eggs in their ovaries.

1952. Yosemite trout investigations, 1951-1952; comprehensive review of trout fishery problems of Yosemite National Park. U.S. National Park Service 296 pp.

"At some early, unrecorded date, the Dolly Varden trout, *Salvelinus malma* Walbaum supposedly was planted in one of the chain lakes on the southern boundary of the park and in the Merced River in Yosemite Valley. The observations of others in recent years and my investigations of 1951 failed to reveal the present occurrence of this species in any of the Chain Lakes."

The same statement in effect can be found in 1955 Evans & Wallis. Fishes of Yosemite Park. Yosemite Nature Notes 23(1):5 or in 1958 Evans, Wallis and Gallison, *Ibid.*, 7th revised edition, 32 pages.

1959: An Evaluation of the Fishery Resources of Glacier National Park and Need for Interpreting Research and Management. U.S. Department of the Interior National Park Service, Washington D.C. Jan. 16, 1959, 35 pp.

"Dolly Varden Charr or bull trout provide an important fishery in park waters on the west side. It is the western relative of the eastern brook trout: although not quite as colorful. It attains a large size in the lakes and in the larger rivers. The State of Montana has carried on studies of the Dolly Varden Charr in the North Fork of the Flathead River, but much is to be learned of its migrational habits and life history in park waters. Tagging programs carried on by state biologists revealed that Dolly Varden may migrate long distances. Two fish tagged in the state's program traveled 101 and 114 miles respectively from the point of marking before they were recaptured. Detailed indentifications of the Dolly Varden found in the park are to determine if unique forms are being adequately protected in the park."

**Walters, Vladimir**

1955. Fishes of western Arctic America and eastern Arctic Siberia—taxonomy and zoogeography. Bulletin of the American Museum of Natural History. Volume 106: Article 5. 368 pp.

Mentions "Previous Records: As *S. malma*, Colville River mouth and Point Barrow (Murdoch, 1885a 1885b), Kobuk River (Townsend. 1887), Point Hope (Scofield, 1899), Hulahula River (Anderson, 1913)."

Walters considered all alpinoid charrs as *Salvelinus alpinus* until sufficient information was collected to permit a thorough study of the group.



This publication contains an interesting dissertation on the zoogeography of the *Salvelinus alpinus* complex.

**Webb, William E.**

1965. General investigations of water quality at Deadwood Reservoir, Idaho. Idaho Department of Fish and Game. Federal Aid to Fish Restoration, Job Completion Report, Project F34-R-6, January.

p. 2: "Growth of all fish species is relatively slow with the exception of the Dolly Varden which appears to increase in growth rather rapidly, particularly in the third year of life, due probaly to a fish diet. The larval and pupal forms of the midge are by far the most important items of diet of most age classes of fish in the reservoir. Exceptions were the larger cutthroats and both large and small Dolly Varden which fed largely on forage fish species."

p. 16: "Only eleven Dolly Varden were collected in the gill net sets. By scale analysis there were four age classes in this small sample: II, III, IV, and V. There were only three fish in the four-and five-year-old group and all were sexually mature. The scales of all fish in the III, IV, and V age class indicated a significant increase in growth during the third year."

p. 18: Table 5 shows stomach contents of the 11 D.V. were 100% fish.

p. 19: "Eleven Dolly Varden, ranging from 7.7" to 16.5" were collected. Three of the stomachs were empty. The other eight all contained fish including two 3-inch fish found in the stomach of a fish eight inches long. No other food organisms were found. Redside shiners and longnose dace were both identified in the stomach contents. However, since the sample was small no conclusion can be drawn as to how much the Dolly Varden preys on the various fish in the reservoir or what the food habits of the younger Dolly Varden are."

**Weisel, George F.**

1957. Fish guide for intermountain Montana. Montana State University Press, Missoula. 88 pp.

Presents a general description and distribution of *S. malma* in Montana.

**Whitney, Arthur N.**

1956. Comparison of fish populations of six clearwater lakes. Job Completion report, 1955-1956, Federal Aid in Fish Restoration, Project F-12-R-2. Montana, 19 pp.

"The six main Clearwater lakes were netted simultaneously by six survey crews on June 5-10, 1955. All crews followed the same daily schedule. All fish captured were counted, weighed and measured and scale samples were mounted, aged and analyzed for rate of growth.

"Comparison of lakes were made by catch per night of species and by growth rates of species. Data is presented by fiducial intervals of catch per net night at the 80, 90 and 95 percent levels and of calculated length at each annulus formation at the 95 percent level.

"Indications of daily and seasonal catch variations between lakes are shown to demonstrate the necessity of of netting all the lakes at the same time in order to minimize these variations."

Data on Dolly Varden include their abundance and distribution within the lakes and age and growth.

1957. Comparisons of fish populations of six clearwater Lakes. Job Completion Report, 1956-1957, Federal Aid in Fish Restoration, Project F-12-R-3, Western Montana fishery study, 11 pp.

"The six main Clearwater Lakes were netted simultaneously by six survey crews on June 17-22, 1956. Each crew followed the same daily schedule, and net sets were made at the same locations in each lake at which they were made in 1955. All fish captured were weighed, measured and recorded. Scale samples were taken only from

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Kubo, 1967 (Japan).
Morton, 1942 (Alaska).
Nakamura, 1963 (Japan).
Needham and Vaughan, 1952 (Idaho).
Rounsefell, 1962 (North America).

**Condition Factor:**
Baade, 1955c (Alaska).
Gibson and Chapman, 1967 (Idaho).
Heiser, 1965; 1966 (Alaska).
Holloway, 1945 (Montana).
Wallis, 1948 (Oregon).

**Description:**
Andriyashev, 1954 (USSR).
Bajkov, 1927 (Canada).
Behnke and Shimizu, 1962 (Japan).
Berezantsev, 1955 (USSR).
Berg, 1923; 1932; 1933; 1948 (USSR).
Carl, Clemens and Lindsey, 1959 (general).
Clemens and Wilby, 1961 (general).
Cope, 1873 (Alaska).
Crawford, 1925 (Washington).
DeLacy and Morton, 1942 (Alaska).
Dufresne, 1946 (Alaska).
Dul'keit, 1927 (USSR).
Dymond, 1932; 1936; 1937 (Canada).
Evermann, 1893 (Montana).
Evermann and Goldsborough, 1907 (Alaska).
Girard, 1857 (general).
Goode, 1887 (general).
Goode and Gill, 1903 (general).
Gordon, 1954 (general).
Gunther, 1866 (general).
Haig-Brown, 1947 (North America).
Hikita, 1962 (Japan).
Jordan, 1894 (North America); 1905a (general); 1907 (North America); 1922 (Alaska); 1925 (general).
Jordan and Evermann, 1896; 1902 (North America).
Jordan and Gilbert, 1882a (North America).
Kaganovskii, 1955 (USSR).
La Rivers, 1962 (general).
Lindberg and Dul'keit, 1929 (USSR).

**Description:** (Cont.)
Lindsey, 1956b (Canada).
Lord, 1867 (Canada).
McPhail, 1961 (Alaska).
Morton, 1942 (Alaska).
Morton and Miller, 1954 (general).
Neave, 1943 (general).
Nelson, 1887 (Alaska).
Okada, 1960 (Japan).
Oshima, 1961 (Japan).
Pochekaev, 1949 (USSR).
Schrenkeisen, 1938 (North America).
Schultz, 1963 (North America).
Snyder, 1940 (California).
Suckley, 1874 (North America).
Tanaka, 1909 (Japan).
Walbaum, 1792 (USSR).
Wales, 1957 (California).
Weisel, 1957 (Montana).
Wilimovsky, 1958 (Alaska).

**Digestive Rate:**
Armstrong, 1963; 1965b (Alaska).
Armstrong and Blackett, 1966b (Alaska).

**Distribution:**
Andrews, 1965 (Alaska).
Andriyashev, 1937; 1954 (USSR).
Baade, 1962; 1965 (Alaska).
Bean, 1880 (California); 1882a; 1883; 1887 (Alaska); 1888 (general); 1889; 1890 (Alaska).
Behnke and Shimizu, 1962 (Japan).
Berg, 1931; 1932; 1934 (USSR).
Carl, Clemens and Lindsey, 1959 (general).
Clemens and Wilby, 1961 (general).
Dimick and Merryfield, 1945 (Oregon).
Dufresne, 1946 (Alaska).
Dul'keit, 1925; 1927 (USSR).
Dymond, 1932; 1936; 1937; 1942 (Canada).
Evermann, 1893 (Montana); 1897 (Idaho).
Evermann and Bryant, 1919 (California).
Evermann and Clark, 1931 (California).
Evermann and Goldsborough, 1907 (Alaska).
Foskett, 1947 (Canada).
Gilbert, 1895 (Alaska).
Gilbert and Evermann, 1894 (Pacific Northwest).



**Distribution:** (Cont.)
Gilbert and Burke, 1910 (Alaska and USSR).
Greenbank, 1954 (Alaska).
Halkett, 1913 (general).
Hanavan and Tanonaka, 1959 (general).
Hanzel, 1961 (Montana).
Hartman, Heard and Dewey, 1966 (Alaska).
Henshall, 1906 (Montana).
Holloway, 1945 (Montana).
Inamura and Morizumi, 1962 (Japan).
Ishida, 1942 (Japan).
Jordan, 1878 (Oregon); 1887 (Washington); 1888 (Canada); 1905 (Japan); 1907 (North America); 1922 (Alaska); 1928 (general).
Jordan and Gilbert, 1882a; 1882b (North America).
Jordan and Starks, 1895 (Washington).
Jordan and Snyder, 1902 (Japan).
Jordan, Tanaka and Snyder, 1913 (Japan).
Kemmerer, Bovard and Boorman, 1924 (Idaho and Washington).
Kincaid, 1919 (Washington).
Kitahara, 1904 (Japan).
Kobayashi and Ueno, 1956 (general).
Krokhin, 1935 (USSR).
Kurenkov, 1965 (USSR).
Kuroda, 1953 (Japan).
La Rivers, 1962 (general and Nevada).
La Rivers and Trelease, 1952 (Nevada).
Lindberg, 1927a; 1937; 1947 (Japan).
Lindsey, 1956a; 1956b; 1957 (Canada).
Marsh and Cobb, 1909 (Alaska).
McAfee, 1966 (general).
McDonald, 1894 (Alaska).
McPhail, 1961 (Alaska).
McPhail and Lindsey, 1958 (Alaska).
Miller and Morton, 1952 (Nevada).
Moiseev, 1936 (USSR).
Mori, 1927; 1928; 1934 (Korea).
Morton, 1968a; 1968c (Montana).
Moser, 1902 (Alaska).
Neave, 1949 (Canada).
Nelson, 1887 (Alaska).
Nikol'skii, 1956 (USSR).
Okada, 1960 (Japan).
Oshima, 1961 (Japan).

**Distribution:** (Cont.)
Popov, 1933 (USSR).
Redick, 1967a (Alaska).
Regan, 1914 (general).
Rostlund, 1951 (Utah); 1952 (North America).
Rozov, 1938 (USSR).
Rutter, 1907 (California).
Schmidt, 1950 (USSR).
Schultz, 1941 (Montana).
Schultz and DeLacy, 1935; 1936; 1936b (Pacific Northwest).
Scofield, 1899 (Alaska).
Soldatov, 1938 (USSR).
Soldatov and Lindberg, 1930 (USSR).
Suvorov, 1948 (USSR).
Tanaka, 1931 (Japan).
Taranets, 1937b; 1938a; 1938b (USSR).
Turner, 1886 (Alaska).
Vladykov, 1963 (general).
Wadman, 1962; 1963a (Alaska).
Wales, 1939; 1957 (California).
Wallis, 1952 (California).
Walters, 1955 (general).
Weisel, 1957 (Montana).
Wilding, 1939 (Alaska).
Williams, 1964 (Alaska).
Wynne-Edwards, 1952 (general).

**Early Life History:**
Armstrong, 1963 (Alaska).
Bjornn, 1961 (Idaho).
Blackett, 1968 (Alaska).
Block, 1955 (Montana).
Heiser, 1965; 1966 (Alaska).
Jeppson, 1960b (Idaho).
Kazarnovskii, 1962 (USSR).
Kubo, 1967 (Japan).
Newman, 1960 (general).

**Embryology:**
Blackett, 1968 (Alaska).

**Fecundity:**
Armstrong, 1963 (Alaska).
Blackett, 1968 (Alaska).
Brunson, 1952 (Montana).
Darda, 1964 (USSR).
Heimer, 1965 (Idaho).
Marriott, 1965 (Alaska).
Nagata, 1967 (Alaska).
Rounsefell, 1957 (Montana).
Shebley, 1931 (California).
Wallis, 1948 (Oregon).

**Food Habits:**

Allin, 1953; 1955 (Alaska).
Andrievskaya, 1957 (USSR).
Armstrong, 1963; 1965b; 1967 (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Banta, 1936; 1937 (Alaska).
Barnaby and DeLacy, 1938 (Alaska).
Berg, 1948 (USSR).
Bjornn, 1957 (Idaho).
Brett, 1946 (Canada).
Brunson, 1952 (Montana).
Chamberlain, 1907 (Alaska).
Chapman and Quistorff, 1938 (Washington).
Chipperfield, 1938 (Alaska).
Darda, 1964 (USSR).
DeLacy, 1941 (Alaska).
Evermann and Meek, 1898 (Idaho).
Foerster, 1930 (Canada); 1968 (general).
Foerster and Ricker, 1942 (Canada).
Godfrey, 1955 (Canada).
Greenbank and Nelson, 1959 (Alaska).
Haley, 1962 (Alaska).
Hartman, Strickland and Hoopes, 1962 (Alaska).
Higgins, 1940 (Alaska).
Jeppson, 1960b; 1963b (Idaho).
Jeppson and Platts, 1959 (Idaho).
Kazarnovskii, 1962 (USSR).
Kokhmenko, 1965 (USSR).
Krogius and Krokhin, 1948 (USSR).
Lagler and Wright, 1962 (Alaska).
Locke, 1929 (general).
Logan, 1962; 1963 (Alaska).
McCart, 1967 (Canada).
Metsker, 1967 (Alaska).
Miller, 1954 (Canada).
Morton, 1942 (Alaska); 1968b (Montana).
Narver and Dahlberg, 1965 (Alaska).
Neave and Bajkov, 1929 (Canada).
Nelson, 1959 (Alaska).
Nikol'skii, 1948; 1953 (USSR).
Nishio, 1934 (Japan).
Noerenberg, 1960 (Alaska).
Nursall, 1949 (Canada).
Olson, 1962 (Alaska).
Popov, 1958 (USSR).

**Food Habits:** (Cont.)

Pritchard, 1936 (Canada).
Raleigh, 1956 (Alaska).
Rawson, 1937 (Canada).
Reed, 1964; 1967a (Alaska).
Ricker, 1933; 1941; 1960 (Canada).
Roos, 1959 (Alaska).
Savvaitova, 1960; 1961c (USSR).
Savvaitova and Reshetnikov, 1961 (USSR).
Semko, 1948; 1954a; 1954b (USSR).
Smoker, 1956 (Alaska).
Sparrow, Larkin and Rutherglen, 1964 (Canada).
Thompson and Tufts, 1967 (Washington).
Townsend, 1942 (Alaska).
Wadman, 1963b (Alaska).
Wallis, 1948 (Oregon).
Webb, 1965 (Idaho).

**Growth:**

Allin, 1953 (Alaska).
Armstrong, 1963; 1967 (Alaska).
Bajkov, 1927 (Canada).
Barnaby and DeLacy, 1938 (Alaska).
Bjornn, 1957 (Idaho).
DeLacy, 1941 (Alaska).
Heimer, 1965 (Idaho).
Heiser, 1965; 1966 (Alaska).
Higgins, 1940 (Alaska).
Huston, 1965 (Montana).
Morton, 1968b (Montana).
Neave and Bajkov, 1929 (Canada).
Nikol'skii, 1948; 1953 (USSR).
Rahrer, 1963 (Montana).
Raleigh, 1956 (Alaska).
Reed, 1967b (Alaska).
Revet, 1962 (Alaska).
Webb, 1965 (Idaho).
Whitney, 1956 (Montana).
Wright, 1960 (Alaska).

**Habits (general):**

Andriyashev, 1954 (USSR).
Armstrong, 1965d (Alaska).
Bean, 1890 (general).
Budd, 1968 (Washington).
Carl, Clemens and Lindsey, 1959 (general).
Clemens and Wilby, 1961 (general).
Dufresne, 1946 (Alaska).
Dymond, 1932 (Canada).
Evermann and Goldsborough, 1907 (Alaska).



**Habits (general):** (Cont.)

Haig-Brown, 1947 (North America).
Henshall, 1906 (Montana).
Jordan, 1884; 1907 (North America).
Jordan and Evermann, 1902 (North America).
Jordan and Gilbert, 1882b (North America).
La Rivers, 1962 (general).
Martin, 1967 (Washington).
McDonald, 1894 (Alaska).
Neave and Bajkov, 1929 (Canada).
Nikol'skii, 1950; 1954; 1956 (USSR).
Pravdin, 1928 (USSR).
Saario and Kessel, 1966 (Alaska).
Skinner, 1968 (Montana).
Turner, 1886 (Alaska).
Wales, 1939 (California).
Wallis, 1959 (Montana).
Weisel, 1957 (Montana).

**Homing:**

Armstrong, 1963; 1964; 1965a; 1967 (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Blackett and Armstrong, 1965b (Alaska).
DeLacy, 1941 (Alaska).
Heiser, 1965; 1966 (Alaska).
Higgins, 1940 (Alaska).
Logan, 1964 (Alaska).
Revet, 1962 (Alaska).

**Illustrations:**

Chamberlain, 1907 (Alaska).
Dymond, 1932 (Canada).
Evermann, 1893 (Montana).
Evermann and Goldsborough, 1907 (Alaska).
Martin, 1967 (Washington).
Miyadi, 1966 (Japan).
Nakamura, 1963 (Japan).

**Insecticides, effect of:**

Cope, Gjullin and Storm, 1949 (Alaska).
Gibson and Chapman, 1967 (Idaho).

**Length-weight:**

Allin, 1953; 1954b; 1954c; 1955; 1958; 1959 (Alaska).
Andrews, 1960; 1961 (Alaska).
Andrews, Heckart and Baade, 1966 (Alaska).

**Length-weight:** (Cont.)

Anonymous, 1964 (Alaska).
Armstrong, 1963; 1964; 1965a; (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Baade, 1955c (Alaska).
Bajkov, 1927 (Canada).
Barnaby and DeLacy, 1938 (Alaska).
Bjornn, 1957 (Idaho).
Blackett, 1968 (Alaska).
Blackett and Armstrong, 1965b (Alaska).
Carlander, 1950; 1953 (general).
DeLacy, 1941 (Alaska).
DeLacy and Morton, 1942 (Alas
Dunn, 1960; 1961a; 1961b (Ala
Engel, 1965 (Alaska).
Foerster and Ricker, 1942 (Can
Gretz, 1964 (Alaska).
Haley, 1962 (Alaska).
Hanzel, 1962; 1963 (Montana).
Heimer, 1965 (Idaho).
Heiser, 1965; 1966 (Alaska).
Higgins, 1940 (Alaska).
Jeppson, 1962; 1963a (Idaho).
Logan, 1962; 1963; 1964 (Alask
Mallet, 1964; 1965; 1966a; 196
1968 (Idaho).
Marriott, 1967 (Alaska).
Metsker, 1967 (Alaska).
Miller, 1954 (Canada).
Morton, 1942 (Alaska).
Neave and Bajkov, 1929 (Canad
Rahrer, 1963 (Montana).
Rawson, 1937 (Canada).
Reed, 1967b (Alaska).
Revet, 1962 (Alaska).
Roos, 1959 (Alaska).
Sexsmith, 1962 (Alaska).
Van Wyhe, 1961; 1962; 1963 (Alaska).
Wadman, 1963b (Alaska).
Wallis, J., 1967 (Alaska).
Wallis, O., 1948 (Oregon).
Webb, 1965 (Idaho).
Williams, 1964 (Alaska).
Wright, 1960 (Alaska).

**Life History:**

Armstrong, 1963; 1964; 1965a; 1967 (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Bjornn, 1957 (Idaho).

**Life History:** (Cont.)
Blackett, 1968 (Alaska).
Blackett and Armstrong, 1965b (Alaska).
DeLacy, 1941 (Alaska).
Heiser, 1965; 1966 (Alaska).
Kubo, 1967 (Japan).
McAfee, 1966 (general).
Morton, 1942 (Alaska).

**Marking:**
Armstrong, 1963; 1964; 1965a; 1967 (Alaska).
Armstrong and Blackett, 1966a (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Blackett and Armstrong, 1965b (Alaska).
Bower, 1938 (Alaska).
DeLacy, 1941 (Alaska).
Higgins, 1940 (Alaska).
Logan, 1962; 1963; 1964 (Alaska).
Marriott, 1967 (Alaska).
Revet, 1962 (Alaska).
Smoker, 1956 (Alaska).

**Maturity:**
Allin, 1953 (Alaska).
Armstrong, 1964; 1965a; 1967 (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Baade, 1955c (Alaska).
Blackett, 1968 (Alaska).
Blackett and Armstrong, 1965b (Alaska).
Block, 1955 (Montana).
Darda, 1964 (USSR).
Hanzel, 1966 (Montana).
Heiser, 1965; 1966 (Alaska).
Logan, 1962 (Alaska).
Metsker, 1967 (Alaska).
Miller, 1954 (Canada).
Nikol'skii, 1948; 1953 (USSR).

**Meristic Counts:**
Andriyashev, 1954 (USSR).
Behnke and Shimizu, 1962 (Japan).
Berg, 1948 (USSR).
DeLacy, 1941 (Alaska).
DeLacy and Morton, 1942 (Alaska).
Dymond, 1937 (Canada).
McPhail, 1961 (Alaska).
Morton and Miller, 1954 (general).
Rounsefell, 1962 (North America).
Savvaitova, 1961 (USSR).

**Migration:**
Allin, 1954c; 1958 (Alaska).
Armstrong, 1963; 1964; 1965a; 1967 (Alaska).
Armstrong and Blackett, 1966a (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Baade, 1955b (Alaska).
Banta, 1937 (Alaska).
Barnaby and DeLacy, 1938 (Alaska).
Bjornn and Mallet, 1964 (Idaho).
Blackett, 1968 (Alaska).
Blackett and Armstrong, 1965b (Alaska).
Block, 1955 (Montana).
Bower, 1938 (Alaska).
Chipperfield, 1937a; 1938 (Alaska).
DeLacy, 1941 (Alaska).
Gibson and Chapman, 1967 (Idaho).
Gretz, 1964 (Alaska).
Hanzel, 1962; 1963; 1965; 1966; 1967 (Montana).
Heiser, 1965; 1966 (Alaska).
Higgins, 1940 (Alaska).
Jeppson, 1960b (Idaho).
Kubo, 1967 (Japan).
Logan, 1962; 1963; 1964; 1966; 1967 (Alaska).
Marriott, 1967 (Alaska).
Mattson and Rowland, 1963 (Alaska).
McDonald, 1894 (Alaska).
Meehan, 1966 (Alaska).
Meehan and Siniff, 1962 (Alaska).
Nelson, 1959 (Alaska).
Nikol'skii, 1948; 1953 (USSR).
Okada, 1960 (Japan).
Revet, 1962 (Alaska).
Rounsefell, 1958b; 1962 (North America).
Semko, 1954b (USSR).
Smoker, 1956 (Alaska).
Sprague, 1921; 1938 (Alaska).
Stefanich, 1958 (Montana).
Wallis, J., 1967 (Alaska).
Wallis, O., 1959 (Montana).

**Morphology:**
Andriyashev, 1954 (USSR).
Bajkov, 1927 (Canada).
Behnke and Shimizu, 1962 (Japan).
Berg, 1948 (USSR).
DeLacy, 1941 (Alaska).
DeLacy and Morton, 1942 (Alaska).
Dymond, 1937 (Canada).
Evermann, 1893 (Montana).



**Morphology:** (Cont.)
Evermann and Meek, 1898 (Idaho).
Jordan, 1878 (Oregon).
McPhail, 1961 (Alaska).
Morton and Miller, 1954 (general).
Oshima, 1961 (Japan).
Ouellette and Qadri, 1968 (general).
Qadri, 1964 (general).
Savvaitova, 1961; 1961a; 1961b (USSR).

**Osteology:**
Morton and Miller, 1954 (general).
Norden, 1961 (Canada).
Qadri, 1964 (general).

**Parasites:**
Akhmerov, 1954; 1955 (USSR).
Bangham and Adams, 1954 (Canada).
Banta, 1936 (Alaska).
Bjornn, 1957 (Idaho).
Bogdanova, 1960; 1963 (USSR).
Evermann and Meek, 1898 (Idaho).
Gusev, 1951 (USSR).
Hoffman, 1967 (North America).
Margolis, 1967 (Canada).
Morton, 1942 (Alaska).
Neiland, 1962 (Alaska).
Northcote, 1957 (Canada).
Pavlovskii, 1954 (USSR).
Reed, 1967b (Alaska).
Schwartz, 1937 (Alaska).
Shaw, 1947 (Oregon).
Trofimenko, 1962 (USSR).
Yamaguti, 1941 (Japan).

**Population Density:**
Allin, 1954c; 1958 (Alaska).
Armstrong, 1963; 1964; 1965a; 1967 (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Bjornn, 1967 (Idaho).
Blackett, 1968 (Alaska).
Blackett and Armstrong, 1965b (Alaska).
Conkle and Raleigh, 1960 (Alaska).
Conkle, Raleigh and Owen, 1958 (Alaska).
DeLacy, 1941 (Alaska).
Domrose, 1967 (Montana).
Foerster and Ricker, 1942 (Canada).
Gibson and Chapman, 1967 (Idaho).
Logan, 1962; 1963; 1964 (Alaska).
Marriott, 1965; 1966 (Alaska).

**Population Density:** (Cont.)
Mattson and Hobart, 1962 (Alaska).
Mattson and Rowland, 1963 (Alaska).
Nelson, J., 1965 (Canada).
Nelson, P., 1959 (Alaska).
Raleigh, 1956 (Alaska).
Revet, 1962 (Alaska).
Sexsmith, 1963 (Alaska).
Whitney, 1956; 1957 (Montana).

**Predation:**
Armstrong, 1963; 1965b; 1967 (Alaska).
Armstrong and Winslow, 1968 (Alaska).
Barnaby and DeLacy, 1938 (Alaska).
Bjornn, 1957 (Idaho).
Brett, 1946 (Canada).
Chapman and Quistorff, 1938 (Washington).
Chipperfield, 1938 (Alaska).
Clemens, 1934 (Canada).
DeLacy, 1941 (Alaska).
DeLacy and Morton, 1942 (Alaska).
Elrod, 1930 (Montana).
Evermann and Meek, 1898 (Idaho).
Foerster, 1968 (general).
Foerster and Ricker, 1942 (Canada).
Gard and Drucker, 1963 (Alaska).
Higgins, 1940 (Alaska).
Jeppson, 1963b (Idaho).
Kanid'ev, 1966 (USSR).
Kirkwood, 1962 (Alaska).
Kokhmenko, 1965 (USSR).
Krokhin and Krogius, 1934 (USSR).
Kutchin, 1902; 1905 (Alaska).
Kuznelsov, 1928 (USSR).
Lagler and Wright, 1962 (Alaska).
Logan, 1963 (Alaska).
Marsh and Cobb, 1908 (Alaska).
McCart, 1967 (Canada).
Moser, 1899 (Alaska).
Narver and Dahlberg, 1965 (Alaska).
Nelson, 1959 (Alaska).
Noerenberg, 1960 (Alaska).
Olson, 1962 (Alaska).
Popov, 1958 (USSR).
Pritchard, 1936 (Canada).
Reed, 1967a (Alaska).
Ricker, 1933; 1941 (Canada).
Roos, 1959 (Alaska).
Rounsefell, 1958a (Alaska).
Ryckman, 1925 (Oregon).
Savvaitova, 1960; 1961c (USSR).
Savvaitova and Reshetnikov, 1961 (USSR).
Semko, 1948 (USSR).